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THE GEOGRAPHICAL JOURNAL

Vol LXXII No 3 September 1928

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In his Anniversary Address, printed in the August number of the *Journal*, the President declared the intention of the Council to open a subscription to the Building Fund for Hall and Library. A general appeal to Fellows will be issued early in October. Meanwhile the Council have great pleasure in announcing that they have already received very substantial donations and promises, which encourage them to believe that their proposals will receive the general assent and generous support of the Society.

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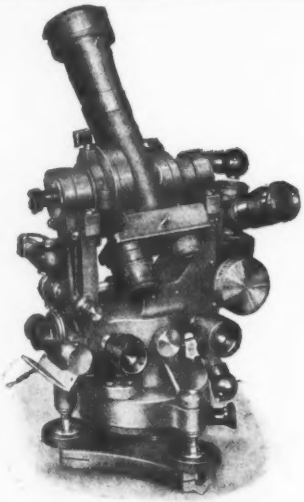

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THE HOUSE OF THE SOCIETY is open to Fellows on week-days from 10 a.m. to 6 p.m. The attention of Fellows is called to the WATER-COLOUR DRAWINGS by members of the Scientific Staff of the R.R.S. *Discovery* now shown in the Exhibition Room.

The First EVENING MEETING of the Session 1928–29 will be held at the Aeolian Hall on Monday November 5, when the THIRD ASIA LECTURE will be delivered by Mr. Owen Lattimore. FELLOWS' TICKETS for the Session will be issued early in October, with dates of all Meetings for the Session, and a provisional programme will be published in the *Journal* for October.

Corrections of style and address for the LIST OF FELLOWS revised to 30 September 1928 should be sent to the Chief Clerk by that date.

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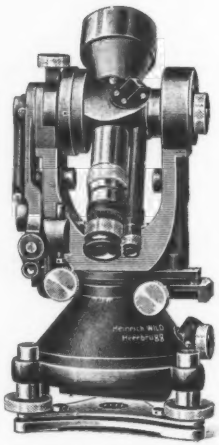

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The
GEOGRAPHICAL JOURNAL

Vol LXXII No 3 R.G.S. *September 1928*

THE WORK OF THE ROYAL RESEARCH SHIP "DISCOVERY" IN THE DEPENDENCIES OF THE FALKLAND ISLANDS:

A paper read at the Meeting of the Society on 2 April 1928 by

A. C. HARDY, M.A.

THE Society will have a double interest in the expedition, for apart from her present work, the *Discovery* herself was originally very largely its own ship. The present expedition cannot in any way be likened to the heroic explorations of Capt. Scott; it suffered none of the trials and hardships which attend terrestrial polar journeys, for it was not concerned with the geography of the Antarctic continent itself but with the exploration of the sub-Antarctic seas.

Whilst I do not intend to go in any detail into the technical side of our work, but rather to select those parts of it which are of a geographical nature, I want to give first of all some idea of the aims of the expedition: its why and wherefore. To appreciate these aims it is necessary to have some knowledge of the development of oceanography, particularly upon its biological side. So wide is the field of geography and so specialized have its many compartments become that few geographers can hope to be familiar with every branch of the whole and especially with those which overlap into the region of another science. It will not be out of place therefore if, by way of introduction, I sketch in the merest outline the development of this very young science of the sea.

We realize how very young a science it is when we remember that the first samples of the sea-bottom were not brought up until 1854 and then only in minute quantities, and that zoologists debated whether the animals which produced the small globular shells found in the ooze lived on the sea-bottom or, as was soon found, in the upper layers of the water. Those who held the latter and correct view did so on the false grounds that it would be impossible for animal life to exist below 300 fathoms. This was the generally accepted view. In 1868, however, Wyville Thomson and Carpenter on the *Lightning* and *Porcupine* expeditions used the dredge down to 650 fathoms and showed that as far as they went there was a rich and varied fauna. These results, together with a proposal to lay a transoceanic cable, led to the dispatch in 1872 of the great *Challenger* Expedition, which after voyaging for three and a half years brought back such a wealth of

information on the physical and biological conditions of the ocean. This we may regard as the birth of real oceanography. It has been followed by a number of marine expeditions sent out by different nations.

Whilst the dredge was revealing a new world of life on the ocean floor, the tow-net—a conical net of fine-mesh muslin or silk towed through the water—was showing us a host of minute organisms, animals and plants, suspended in the upper layers. It was first used by Johannes Müller in 1845, and then by G. O. Sars, Edward Forbes, Wyville Thomson, and an increasing number of workers to the present day. In 1887 Hensen, who made an intensive study of this kind of life, introduced the term "plankton"* to designate all those forms which are passively drifted by currents, winds, and tides in contradistinction to those animals, such as fish and whales, which can actively migrate against them. I shall have a good deal to say about the plankton, so that I am anxious that its importance in the economy of marine life should be fully realized. We shall realize it, I think, if we ask ourselves upon what does all the fish life of the sea feed? Let us consider the herring alone. Some ten thousand millions of these fish are landed from the North Sea at ports in this country; these, with those landed at foreign ports, must be only a small proportion of all the herrings in the North Sea. If we were to imagine for a moment that these herrings were land animals and feeding directly upon plants, sweeping in their millions across the continents—then we must also imagine the whole countryside stripped of vegetation as if by locusts. We know that all animals must depend either directly or indirectly

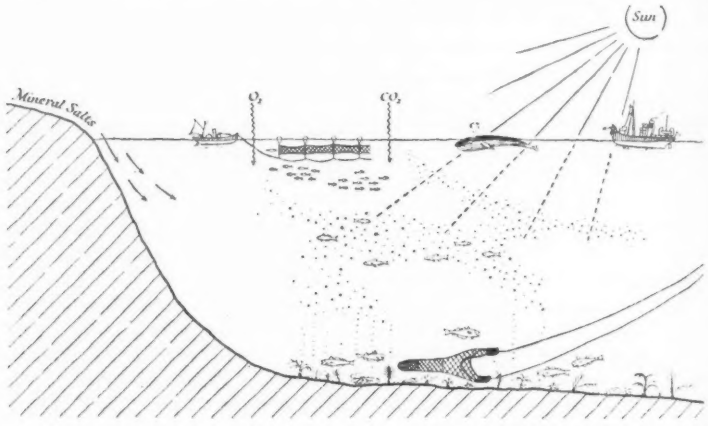


Fig. 1. *Economy of marine life*

upon plant life. Where, then, in the sea is this plant life which will support not only the herrings but all the other teeming fish and invertebrate animal life? The seaweeds will not suffice; they form but a fringe in the shallow waters by the coast. The tow-net has given us the answer: it is in the plankton.

*πλαγκτον, that which is drifted.

In the accompanying diagram, Fig. 1, I have attempted to portray the economy of marine life in as simple a form as possible. The sun's rays penetrate into the upper layers of the water; oxygen and carbon dioxide are dissolved from the atmosphere and mineral salts are brought in from the land by rivers. These are ideal conditions for plant life; the sea is one great culture medium. Just as the agents favouring life are scattered through the medium, so is life itself; it is scattered as a fine aquatic dust of microscopic single-celled plants in untold billions. Upon these plants feed a host of more or less microscopic animals in which all the large groups in the animal kingdom are represented—if not in adult life then in their younger stages. By far the most important of these animals are the small crustacea; the ocean teems with them, they are the " insects " of the sea. Pelagic fish, such as the herring, pilchard, and mackerel, and the great whalebone whales, with which this expedition is primarily concerned, feed directly upon these plankton animals. From this planktonic world there falls to the sea-bottom a never-ending rain of dead and dying material which feeds the life of the depths; on the sea-bottom are " forests " of plant-like animals which, rooted to the ground, stretch out their arms and tentacles umbrella-like to catch this rain of falling food. Upon these, again, feed the creeping animals and the bottom-living fishes. Then comes man sweeping the bottom with his trawl, catching the herring and mackerel in miles of drifting net and with powerful ship and explosive shell shooting the great whales for their oil. Out of the North Sea alone about one and a half million tons of fish are taken every year, and from the Dependencies of the Falkland Islands between a quarter and half a million barrels of oil.

It is not surprising, then, that man is at last beginning to make a study of the conditions underlying this supply. The beginning of this century saw the formation of the International Council for the Exploration of the Sea: the different nations of Europe each undertaking a series of investigations to form part of one great plan. Not only are they inquiring into the life of the fish themselves—their life-history, food and feeding habits, migrations, age, growth, etc.—but, with continually improving oceanographical equipment, into the distribution of the different plankton forms and the conditions under which they live, the movement of water masses, the chemistry of the sea, the nature and fauna of the sea-bottom.

It is investigations just such as these, together with cartographical surveying, that make up the work of the *Discovery* Expedition; only here it is not so much the fish life which forms the *raison d'être*, but that of whales.

In the year 1904, following the reports on the number of whales in the South made by expeditions, the first whaling station was established in South Georgia, and in the following season a floating factory first visited the South Shetlands. So successful were these enterprises that by 1911 there were eight companies working in South Georgia and twelve floating factories at the Shetlands. The whales taken here, apart from the Southern Right and Sperm whales which are only occasionally met with, belong to three species; these are the two large rorquals—the blue and the fin whales, and the humpback whale. These are all toothless whales, that is to say plankton feeders which separate the small shrimps from the water by means of the sieving apparatus of baleen plates in the mouth.

In 1911–12 a whaling expedition visited the South Sandwich Islands, but was a failure, and a similar enterprise in the South Orkneys met with little success and was given up in 1915. In South Georgia and the South Shetlands, however, the industry continued to flourish, so that in 1912–13 there were twenty-one catchers working in South Georgia and thirty-two in the South Shetlands. All these islands, with a section of the Antarctic continent itself, are part of the British Empire, being the Dependencies of the Falkland Islands (see Fig. 2). The number of licences issued to the companies, mainly Norwegian, was and is strictly limited; but during the war, when the oil became of great importance as a source of glycerine for munitions, the restrictions were relaxed, and in 1915–16 the number of whales taken in a single season reached a record of 11,792.

Never before has whaling been carried on on such a scale. It is of interest here to recall the remarkable prophecy of Dr. George Forster, who accompanied Capt. Cook on his voyage in the *Resolution* when he discovered and laid claim to South Georgia. He wrote in his account of the voyage as follows:

> "If the northern ocean should ever be cleared of whales by our annual fisheries, we might then visit the other hemisphere where these animals are known to be numerous. However, there seems to be little necessity to advance so far as New Georgia in quest of them, since the Portuguese and North Americans have of late years killed numbers of them on the coast of America, going no farther than the Falkland Islands. It should therefore seem probable, that though Southern Georgia may hereafter become important to mankind, that period is at present so far remote and perhaps will not happen, till Patagonia and Tierra del Fuego are inhabited and civilized like Scotland and Sweden."

It is now no longer a question of "*if* the northern ocean should be cleared of whales then we might visit the other hemisphere"; man *has* "cleared" the northern seas and *is* visiting the other hemisphere. Who will doubt that, if he does not regulate his industry, he will clear these waters too? Since Forster's day, only a hundred and fifty years ago, the world has seen the Greenland Right whale brought almost to extinction; the Fur seals in the very Dependencies we are considering wiped out of existence by a few seasons' butchery; the Pacific Sea-Cow, like the Dodo, exterminated a few years after its discovery; and then the rise and the decline, through overfishing, of the northern rorqual fishery. Man, unless his industry is governed, is never content with the golden eggs, but must always kill the goose—not so much through the amorality of the individual but through the economic pressure of his competitive society. As Dr. Kemp has pointed out, we do not fear that the rorquals will be actually exterminated, because the industry must fail long before the whales are reduced to the point of extinction. We fear the collapse of the industry—the loss of this valuable supply of oil, if not for ever, for a very long time to come, and we know that any restrictive legislation that must be made, whether nationally or internationally, must be based upon the findings of scientific research. I do not wish to be misunderstood here. We are not accusing the Norwegians, who carry on this industry, with wantonly destroying the whale—we have the greatest admiration for their enterprise, skill, and hardiness, and for their careful regard to our

regulations. They too have shown us the greatest hospitality and given us every assistance in our work. Our expedition is in no way political—it is out only to find facts so that they may be ready to serve the industry before signs of decline become apparent.

In 1917, as the result of several memoranda prepared by Mr. Darnley of the Colonial Office, the Secretary of State for the Colonies, at that time Mr. Long, constituted an inter-departmental committee to advise him on research and development in the Dependencies of the Falkland Islands. Its terms of reference were :

> " To consider what can now be done to facilitate prompt action at the conclusion of the War in regard to the preservation of the whaling industry and to the development of other industries in the Dependencies of the Falkland Islands ; and to consider not only the economic questions above referred to and the scheme for the employment of a research vessel, but also what purely scientific investigations are most required in connection with these regions, and whether any preliminary inquiries by experts in this country should be instituted."

In 1923 the *Discovery* was bought from the Hudson Bay Company and almost entirely reconstructed. Dr. Stanley Kemp was appointed Leader of the Expedition and Director of Research, and Commander Stenhouse, D.S.O., D.S.C., appointed captain of the ship. Reconstruction of the ship took longer than was originally expected, and she did not finally sail until 5 October 1925. In the meantime a shore station—a well-equipped biological laboratory—had been established the previous Christmas at Grytviken, South Georgia, in charge of Mr. Mackintosh.

The work of the expedition, apart from the cartographical surveying, may be divided into two classes : that done directly upon the whales themselves and carried out almost entirely at the shore station at Grytviken or at stations on the African coast ; and that upon the environment of the whale, carried out by the *Discovery*, assisted later by a smaller ship, the R.S.S. *William Scoresby*, under the command of Capt. Mercer. At Grytviken, Messrs. Mackintosh and Wheeler, and for a time Mr. Hamilton, working under the trying conditions of the whaling station, amongst the blood, stench, and slime, made detailed measurements and observations on over sixteen hundred whales. Their work, amongst other things, is revealing for the first time the long-wanted information regarding the breeding times, period of gestation, rate of growth, and age of maturity. Mr. Matthews carried out important investigations into the food of whales, and made a special study of the Elephant Seals—which like the whales—are taken for their oil, as well as a study of the bird life of the island ; and Mr. Clowes, hydrologist, carried out researches into the chemical composition of the almost endless supplies of water samples landed from our ships : work which builds up the physical background for our picture.

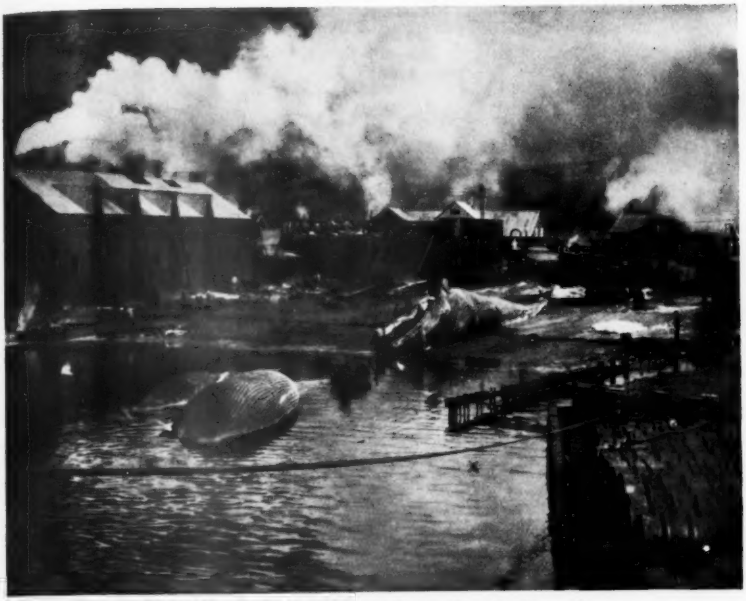
Whilst the work done at the shore station is of the greatest importance, I shall deal in this paper almost entirely with the work of the two ships—the *Discovery* and the *William Scoresby*—the work which is oceanographical and has therefore a direct geographical interest.

We sailed from Falmouth on 5 October 1925, called at Las Palmas, Grand Canary, and after a somewhat slow passage, due to our limited coal supply,

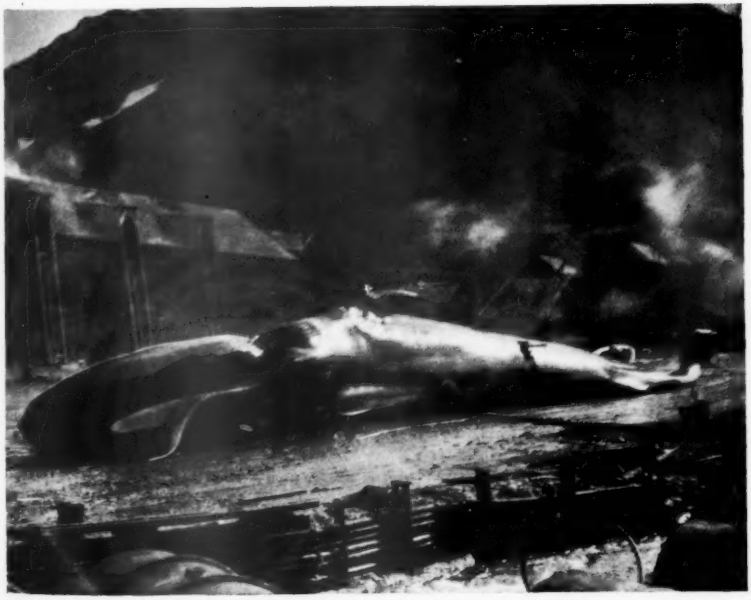
arrived at Cape Town on December 20. On the way we visited Ascension and took on 100 tons of coal. The scientific staff, under the direction of Dr. Kemp, were Mr. Hamilton, Mr. Gunther and myself, zoologists, and Mr. Herdman, hydrologist. Beyond the routine plankton and hydrographical work the ship was well equipped for all classes of oceanography, so that on this passage much time was spent in the trial of gear, including the use of very large deep-water tow-nets—15 feet in diameter. If the passage was somewhat slow, it was full of interest to the zoologist. Bullen in his 'Voyage of the *Cachalot*,' wrote: "To this day I can conceive of no more delightful journey for a naturalist to take than a voyage in a southern whaler especially if he were allowed to examine at his leisure such creatures as were caught." He is right. Here many of us experienced the joys of seeing for the first time the beauty and richness of tropical pelagic life: jelly-fish, pelagic worms and molluscs, and crustacea, all in great variety, to say nothing of the fish and schools of dolphins. Who too will ever forget his first catch from 2000 or 3000 metres depth: the tow-net bucket filled with fantastically shaped fish, often studded with luminous organs; hosts of scarlet crustacea, deep-sea medusæ, patterned and coloured like Turkey carpets, and many other creatures less easily described? In passing I must mention here the remarkable displays of phosphorescence caused by the organism *Pyrosoma*. Technically speaking, it is a pelagic colonial tunicate; actually in appearance it is like an incandescent gas mantle—6 to 9 inches long—made of stiff jelly in which are embedded hundreds of small individual animals, each, when agitated, glowing with a bright blue-green light. For several nights after crossing the equator the ship passed through dense zones of these living lanterns, millions and millions of them, so that a broad patch of light was left behind the ship for half a mile or so. Even more remarkable was a display one night in the Gulf of Guinea, on our return voyage, of another phosphorescent organism, the Ctenophore *Deiopea;* it is a jelly-fish-like animal of the most delicate nature, which from time to time gives out a brilliant and instantaneous flash. Here the effect was again produced by vast numbers, but this time over the whole surface of the sea irrespective of our passage; it was as if we were steaming through shower after shower of submarine rockets which burst just below the surface.

After some small alterations to the equipment of the ship found necessary by the trials on the outward passage, we sailed from Cape Town on January 17 for South Georgia, calling at Tristan da Cunha, where we landed stores and mail. A series of full hydrographic and plankton stations from here to South Georgia was broken by a gale of almost hurricane force, which drove the ship many miles off her course. On February 16 we met our first iceberg, and on the 20th reached South Georgia; it was a day of brilliant sunshine as we approached, and the whole range of jagged snow-white mountains lay before us along the horizon, sharply dividing the intense blue of the sea and sky. At two of the stations on this passage we brought up samples of Radiolarian ooze, the first to be obtained from the Atlantic ocean.

At South Georgia we found the shore party well established in their second season's work, and we remained for two months carrying out the first provisional biological and hydrographical survey of the whaling grounds.



Whaling Station, Grytviken, South Georgia



A large Blue Whale (Balænoptera musculus) on the flensing platform

Mount Paget, South Georgia, from King Edward's Point, Cumberland Bay

R.R.S. "Discovery" leaving Cumberland Bay, South Georgia (note whalebones in foreground)

Mount Paget, from Maiviken Pass, South Georgia

This work was made difficult and much curtailed by many successive gales. However, valuable foundations were laid for comparison with the much more comprehensive survey of the second season. Mr. Matthews' work at the shore station had shown that the South Georgia whales—Blue, Fin and Humpback—feed exclusively upon one organism: the small shrimp-like creature *Euphausia superba*, called by the Norwegians the Krill. Our tow-net samples were giving us some indication of its distribution, and of its competitors, enemies, and food organisms in the plankton. Since all this work is repeated in the fuller work of the next season, I will reserve further remarks upon these problems and pass on as quickly as possible.

We sailed from South Georgia on April 17, making a line of stations to the Falkland Islands. After some trawling, dredging, and plankton stations around the islands, where we found the pelagic larvæ of the bottom-living *Munida gregaria* swarming like miniature lobsters at the surface, we left for Cape Town on May 20. These *Munida* larvæ are thought to be the food of whales in this region. Our course was northerly to investigate the reported Subra and O'Brien shoals; a heavy gale prevented us from sounding in the position of the former, but returning to that of the latter we made our deepest sounding. From here on our passage to the Cape we made a number of deep-water hauls with our larger nets. Among the many interesting captures made was a new species of Prawn, whose luminous organs, each having a red mass of pigment and a blue lens separated by a white crystalline layer, decorated its body as if with red, white, and blue rosettes. We reached Cape Town on June 29.

The ship now went into dry dock, where special sister keels were fitted to her to reduce the rolling which had interfered much with our work; they proved to be a great success, effecting an improvement of at least 25 per cent. In the meantime the shore party had arrived in South Africa, where they continued their work upon the whales landed at the Saldanha Bay whaling station on the west coast some 60 miles north of Cape Town. In September the *Discovery*, when her refit was complete, carried out a series of plankton and hydrographic stations across the whaling grounds off Saldanha Bay.

By this time we had been joined by the R.S.S. *William Scoresby*, a full-powered steam-ship of the whale-catcher type, and with her came Messrs. Dilwyn John and Fraser, zoologists, to join our staff. Her work may be divided into three main categories: whale marking, the taking of plankton and hydrographic samples, and trawling with a full-sized commercial trawl in the region of the Falkland Islands. The first of these will need some explanation. As already hinted, one of the important problems to be solved is that of the migration of whales. We know that they do migrate; but how far and in what direction we have only a vague idea. We know generally that the whales have two main migrations: a feeding one in the spring to the polar waters rich in plankton, and one in the autumn to the lower warmer latitudes for breeding. The work of our shore party has done much to support this. But do the whales which pass up the West African coast for breeding in the southern autumn belong to the same stock as those which were being fished a month or so earlier at South Georgia? Is there a circumpolar migration of whales in the summer? Might a school fished at the

beginning of the season at the South Shetlands be later fished in the Ross Sea and *vice versâ?* Or again, whilst almost incredible, and unlikely in view of the relative scarcity and abundance of whales in the north and south respectively, could it occasionally happen that, since they are known to go as far as the equator to breed, they might pass from one polar hemisphere to

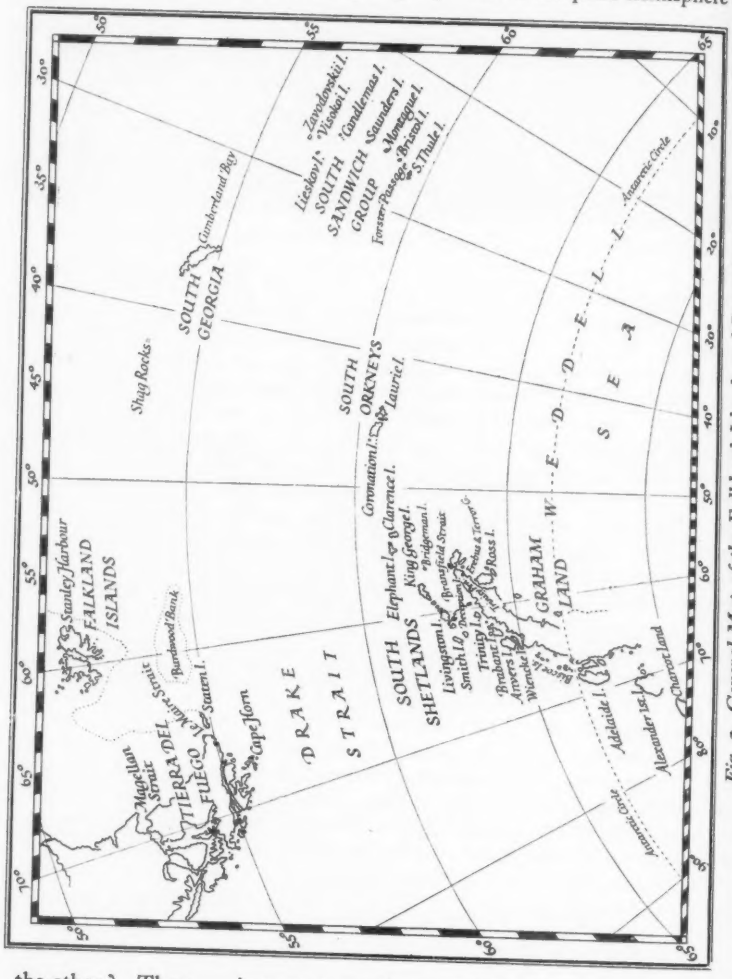


Fig. 2. General Map of the Falkland Islands and Dependencies

the other? These are important questions. We have the migrations of the eel from the deep waters off the West Indies to the fresh waters of Europe, or of birds from South to North America to remind us how extensive and unexpected the movements of animals may be.

During the last twenty years, under the guidance of the International

Council for the Exploration of the Sea, much has been learnt of the migrations of fish by " marking "—that is, by attaching a numbered button to a fish, liberating it at a known point, and recording the position of its subsequent capture. Thousands of fish have been marked in this way, and of them hundreds recaught. By this means not only has migration but intensity of fishing been measured. With whales it is more difficult. We cannot, of course catch a whale, label it, and let it go again ; but we can shoot a mark into its blubber ; and this we do. The mark is like a large drawing-pin ; it is of silver-plated rustless steel and bears upon its disc a number and instructions for its return from the whaling station. Its pin is heavily barbed to hold it in the blubber, and the whole is mounted on a detachable wooden arrow which is shot from a light shoulder gun. The position of shooting is recorded in a log against the number of the mark fired, and a reward offered by leaflet and poster to all the whaling stations of the world for the return of marks and certain data. The first experiments were made on living whales in the summer of 1924 on a cruise to Iceland ; Professor Hjort, who had evolved a similar method, very kindly invited me, as a representative of the *Discovery* Expedition, to accompany him. Here we proved that this method of marking is perfectly practical. But success on a large scale cannot always come at once. In her first year the *William Scoresby*, whilst being very successful in her other work, was unable through unforeseen structural defects to mark enough whales, so that so far no marks have been returned. These structural defects have now been overcome, and the little ship is away in the south again on another attempt which we feel confident will meet with success.

Let us, after this digression, return to the autumn of 1926 and follow the two ships as they start, the *Discovery* on her second, and the *William Scoresby* on her first, season south. The latter left on October 21, making a direct great-circle course for Grytviken, South Georgia, and the *Discovery* a few days later on a different course. The direct course from Cape Town to South Georgia against the prevailing westerly winds and drift is a difficult one for a barque-rigged ship with only auxiliary power and a very limited supply of coal ; especially is this so in the case of the *Discovery*, as we found in the previous season, on account of the extra resistance of her very heavy rigging and none too fine ice-resisting lines. Partly on this account we decided to go straight south from the Cape, through possible pack-ice, to a latitude near to the Antarctic continent, where we might expect calm weather and probably an easterly wind, and so along and north to South Georgia ; and partly to make observations on the number of whales and richness of the plankton, their food, along the edge of the continent and in the region of Bouvet Island. It is of great importance to find out if there is a rich stock of whales around the pole. We were frustrated in our aims—except in regard to Bouvet. We encountered the pack-ice on November 14 in latitude 53° S., icebergs having been very numerous the two preceding days. Fog and poor visibility prevented sights being taken for several days, and when at last the sun showed itself we found that we were some 90 miles to the south-east of Bouvet Island, having been driven in the pack for two days by a strong north-westerly gale. We had now got into thick pack, thicker

Fig. 2. General Map of the Falkland Islands and Dependencies

and farther north than we had expected it; our small supply of coal and the prospect of meeting larger fields of thicker ice to the south of us made the taking of the southerly route too big a risk, so that we turned north and came out of the pack again close to Bouvet Island. Here we got a good view of the island, but were unable to land, for there was thick pack-ice on its lee side. Here our tow-nets showed the presence of Krill (*Euphausia superba*), and whales were numerous.

We now had to take a course straight to the westward. Our coal supply was so short that we had to go for many days on only one boiler, so that the progress against the head wind was very slow. It was an anxious passage: for many days it was a toss-up whether we should reach South Georgia or have to turn and sail back to the Cape, meaning ruin to the second season's work from which we hoped so much. It was a trying passage, too, for the captain and his officers on account of the fog and ice; it seemed to be an abnormal year for ice: on one afternoon watch, with a visibility of only 1 to 2 miles, we sighted as many as sixty large bergs. We made South Georgia at last on Sunday, December 5.

The two ships had each made a series of daily plankton stations, each using double flights of three tow-nets of the same kind and in the same way, so that we had on reaching South Georgia two lines of samples across the southern ocean. These, supplemented by deeper hauls made from the *Discovery*, when fully worked out will give us a valuable picture of the planktonic life of the southern ocean. A provisional analysis and volumetric estimation has already given us the broad outlines—the relative abundance of the principal plant and animal forms. These are shown graphically in Fig. 3. In the region of Bouvet we came into the zone of rich polar plant plankton—the sea being thick in diatoms of many species.

It is here that our work becomes geographical. The exploration of the sea, so different from that of the land, has a fascination of its own. Some will say that with its methodical routine, it is dull and uninteresting. I do not agree with them. It is true that, except for storms and ice, one has not the physical obstructions like mountains and rivers, jungle and desert. I would liken the exploration of a wide stretch of ocean to the crossing of a continent on a road in the dark and trying to build up an idea of the country traversed from the samples of minerals, plant, and animal life clutched and groped for a little way to right and left when stopping at intervals.

In the sea everything is hidden from us. It is only after we haul up our nets, our trawls, our water-sampling apparatus that we can attempt to piece it all together into the geography of the whole and say that here lies a great belt of plankton "jungle," there a comparatively barren area, and here again a zone of cold water coming from the Pole. These characters are not fixed like the forests and deserts of the land; but within certain limits are moved by the ocean currents and increased or diminished in size and density by the climatic conditions from time to time. This makes their geography not impossible, but more difficult; at first we can only sketch out roughly the possible limits of these zones. Later, when our knowledge of the physical conditions underlying their formation, growth, and decline becomes more complete we can say that we may expect such and such in this and that season

Larsen Harbour, Drygalski Fjord, South Georgia

Inside entrance to Drygalski Fjord, South Georgia, looking N.E.

Melchior Harbour, Palmer Archipelago

Fournier Bay, Anvers I., Palmer Archipelago; Discovery I. on right

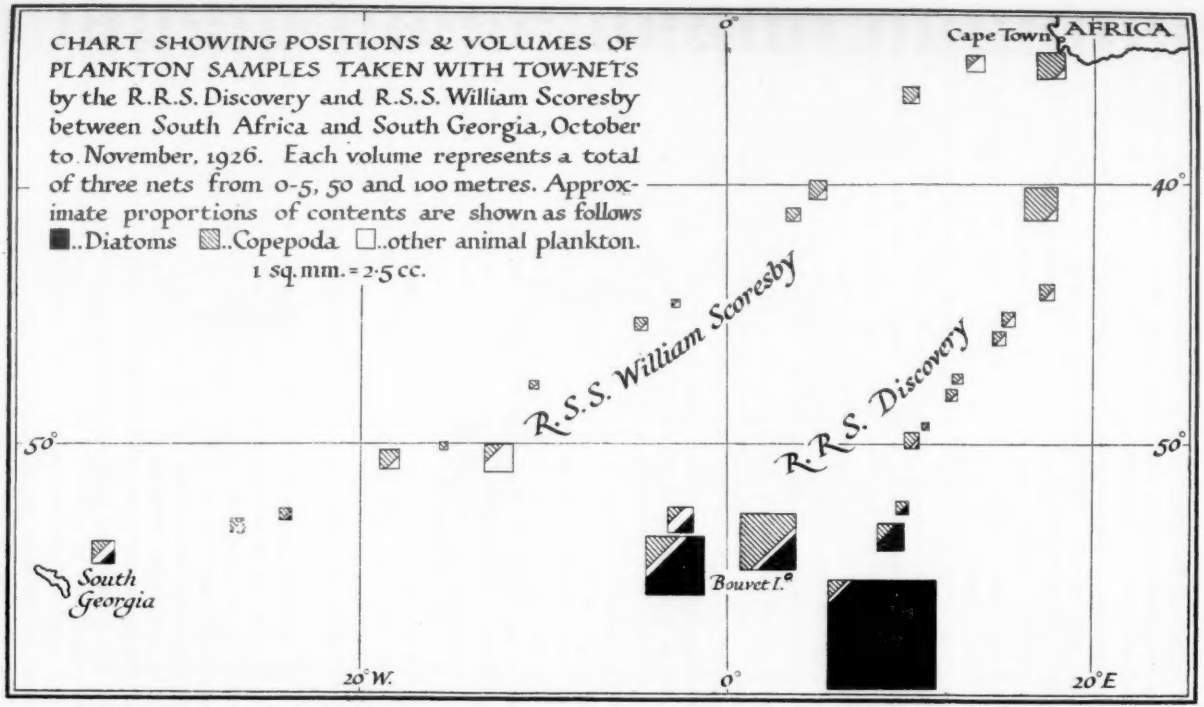


CHART SHOWING POSITIONS & VOLUMES OF PLANKTON SAMPLES TAKEN WITH TOW-NETS by the R.R.S. Discovery and R.S.S. William Scoresby between South Africa and South Georgia, October to November, 1926. Each volume represents a total of three nets from 0-5, 50 and 100 metres. Approximate proportions of contents are shown as follows ■..Diatoms ▨..Copepoda □..other animal plankton.
1 sq. mm. = 2·5 cc.
0°
Cape Town
AFRICA
40°
50°
R.S.S. William Scoresby
R.R.S. Discovery
South Georgia
Bouvet I.°
20° W.
0°
20° E

Fig. 3

and in this and that year. We may be sure that as time goes on these results of oceanography will be welded more and more into the geography of the world as a whole. At present in general works of geography little is said about the ocean beyond the movements of water masses and the deposits of dead shells on the bottom. It is the biological, as well as the physical, characters in this and that stretch of water which are important, affecting man through the fisheries; making cities prosperous and sending men across the world to colonize barren lands. The great regions of summer plankton growth at each Pole, brought about by the long days of sunlight and perhaps the absence of certain bacteria, are almost as striking as the ice-cap itself, and as much stores of solar energy as the plains of wheat and grazing land of lower latitudes. It would not be a bolder prophecy than that of Forster quoted above to say that the time will come in the not too distant future when man will derive food or other power direct from these vast resources.

As soon as the *Discovery* arrived at South Georgia preparations were made for a survey of the whaling grounds. Space will not permit of a detailed account of this. A series of lines of stations was planned radiating from South Georgia, with other intermediate stations between these lines. Their positions are shown in the map in Fig. 4. At each station, following a sounding, water samples were taken for temperature and chemical analysis, as far as depth would permit, from the following levels: 0, 10, 20, 30, 40, 50, 60, 80, 100, 150, 200, 300, 400, 500, 750, 1000, 1500, and 2000 metres. Vertical plankton hauls, the nets being closed at the end of each, were made in a series at a uniform speed covering a complete column of water from 1000 metres to the surface, thus: from 50 m. to the surface, 100 to 50 m., 250 to 100 m., 500 to 250 m., 750 to 500 m. and 1000 to 750 m.; as well as an additional haul with a specially fine net for the smaller plant organisms. Following this work from the stationary ship, two flights of three nets each, one of fine mesh and the other of coarse, were towed for $\frac{1}{4}$ to $\frac{1}{2}$ a mile respectively. These later showed us the distribution of the larger forms, particularly the Euphausians, the whale food. The two ships, working day and night, in close wireless communication with each other, carried out this programme. It was a race against weather conditions, and its successful conclusion was due to the remarkable enthusiasm of every man on board.

The detailed treatment of these samples had of course to await our return; we are at present engaged upon them and their full significance cannot yet be seen, but a rough analysis on the spot led to the following broad conclusions shown in the sketch-map, Fig. 4. These results must be taken as purely provisional, and will no doubt be somewhat modified by the results of detailed examination. We found that all the Euphausians were concentrated along the north-east side of South Georgia. Immediately at each side of the island was a zone some 15 miles broad very poor in plankton, and outside this an encircling zone of thick plant plankton, largely diatoms of the species *Corethron valdiviæ*, with outside this again an area of more mixed but less dense plankton.

We may guess at the explanation of this. South Georgia is a long narrow island, some 100 miles long by some 15 across; it is placed almost at right angles

to the main westerly drift coming up from the Drake Straits. The currents set up round it will be like those set up round any long object forced sideways through a fluid—the water will be forced in a curve round either end to

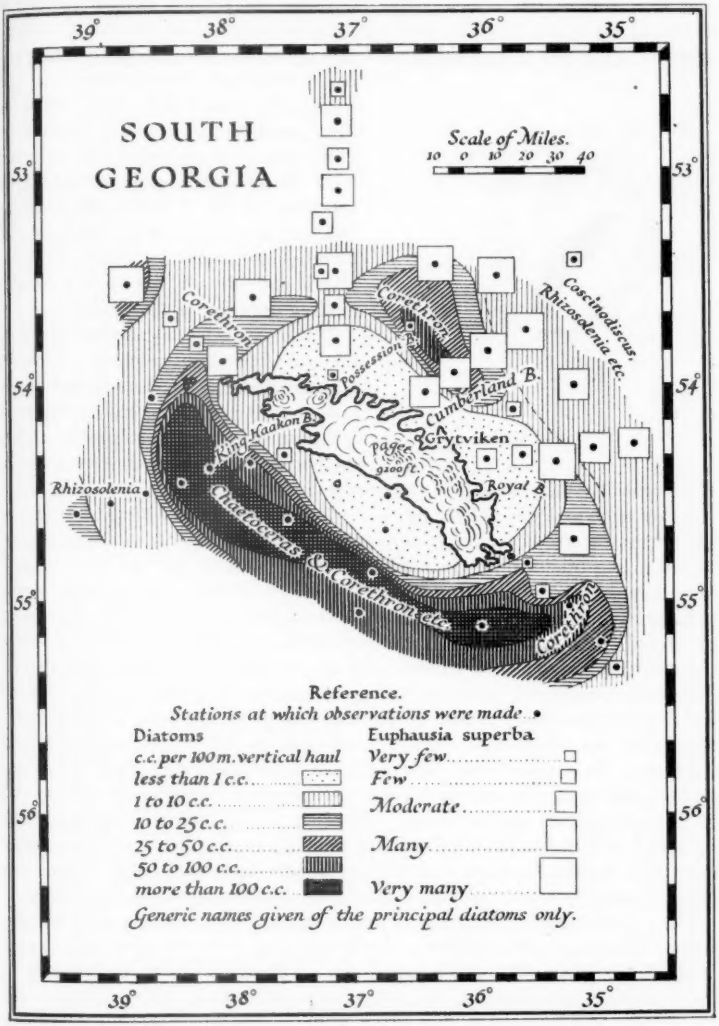


Fig. 4

meet in an eddy some distance behind it, leaving an area of "dead" water immediately against the land. The growth of plant life in the sea is limited, as Atkins has shown, by the quantity of available phosphate. This as the sum-

mer advances gets used up in the upper layers. Here, where the main ocean current from the west strikes the continental shelf of South Georgia, there will be an upwelling of water rich in phosphate from the deeper layers on the west side of the island. It is here that we get the densest growth of diatoms, which are carried round either end into the area behind the island (see Fig. 5). Here in this sheltered water are all the Euphausians, young and old, which feed directly upon the diatoms. It is like a sheltered nursery for them, supplied by food on either side. This theory appears to fit in very well with the results of phosphate analysis obtained by Mr. Clowes, our hydrologist, and is perhaps the explanation why South Georgia, so peculiarly situated, should be one of the richest whale-feeding grounds of the world.

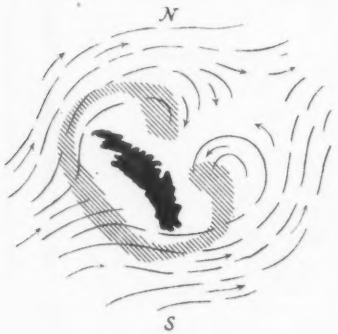


Fig. 5

I will now refer to another and new method of plankton research. Hitherto our knowledge of the density and distribution of the plankton has been gained from samples taken at a number of distinct stations. When, on a long cruise, these stations have to be at considerable distances apart, we may doubt whether such samples are giving us a true idea of the planktonic content of the water traversed : at one point we may strike a swarm of copepods, or between two others miss an important zone of diatoms. For some time I have felt the need of an instrument which by giving a continuous record mile by mile to scale, would enable one to study and compare the uniformity or irregularity in distribution of planktonic life in different areas, to measure the size and frequency of patches, and to indicate more exactly than can be done with comparable tow-nettings—whether any correlation exists between the different species. Whilst on the expedition I have been experimenting with such an instrument, which I am calling the Continuous Plankton Recorder. It is towed like a paravane at any convenient depth below the surface, and in it the organisms are caught upon a continuously moving roll of fine silk netting worked from a propeller in the water. Like most first models it had mechanical defects, and at times went wrong ; but altogether over 2400 miles of plankton were successfully recorded. Fig. 6 shows in graphic form the results of a run from the South Shetlands to Cape Horn.

Here, whilst upon the subject of instruments, I must mention the untiring energy and skill of Mr. Herdman, our hydrologist, who was a veritable doctor of machines. Our ship, as the daily press would say, was full of " gadgets "; hydrographic water-bottles, net-releasing mechanisms, depth gauges, and the C.P.R. just referred to, are but a few ; and upon these Mr. Herdman was continually performing the most delicate operations.

At the beginning of February the two ships left South Georgia : the *William Scoresby* for the Falkland Islands, where until the end of April she carried out an extensive trawling survey between the Falkland Islands

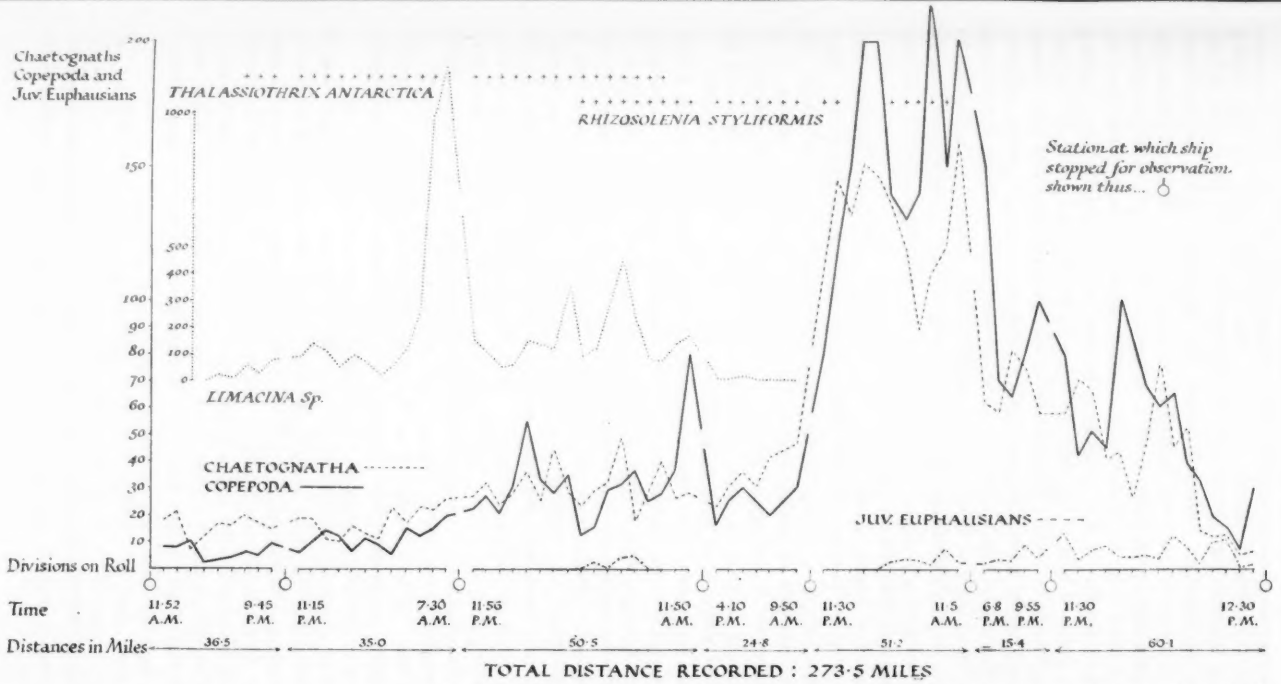


Fig 6. *Graphic representation of a continuous plankton record from the S. Shetlands to Cape Horn showing the varying quantities of the more important organisms taken. Note the correlation of Chætognatha (arrow-worms) and Copepoda (small crustaceaus): the former feed largely on the latter*

and the mainland of South America; and the *Discovery* for the whaling grounds farther south, to the South Orkneys, the South Shetlands, and the Palmer Archipelago. We will follow the *Discovery*. The passage to the South Orkneys was a very boisterous one, and off the Orkneys we met the pack again and a great many bergs: as many as 192 were in sight at one time. After a brief visit to the whaling factory there we proceeded down the Bransfield Straits to the remarkable harbour of Deception Island, passing a large piece of barrier ice over 30 miles in length, and past Clarence and Elephant Island, whence Shackleton set out on his wonderful boat journey to bring rescue to his *Endurance* party. Other still larger pieces of barrier were reported by the whalers; one to the north of the South Orkneys was said to be as large as South Georgia itself. Capt. Stenhouse is charting his ice observations and collecting together the ice records of past years from the logs of whalers and previous expeditions; for it is very important to know how this and that season vary from the normal.

Deception Island is the centre of the South Shetland whaling; here in the circular flooded volcano, entered by one narrow gap in its almost mountainous crater, lie the floating factories in shelter from the gales. The beach is hot and the water steams along its edge in strange contrast to the ice and snow of the higher slopes; in 1924 greater volcanic activity was experienced, and for a short time that part of the harbour in which the vessels lie was said to have actually boiled.

From here we passed southward to Melchior Harbour in the Palmer Archipelago between Brabant and Anvers Islands, where there was another floating factory. For a time rough weather prevented work in the more open waters outside so that we worked inside the islands, passing down into the Gerlache Straits through Neumayer Channel to "Port" Lockroy in Wiencke Island, the harbour discovered by Charcot and used by him in 1904. The scenery here, with the lofty pointed mountains sweeping down to cliffs of ice, must be difficult to equal. Our dredging in this area revealed a remarkably rich and varied benthic fauna; on one occasion the catch from a five-minutes' haul with the dredge kept the zoological staff busy sorting and preserving for nearly twenty-four hours. These hauls also kept our doctor busy—although happily not in his professional capacity; Dr. Marshall, often using ultra-violet light, has made a remarkable series of photographs of many of the living animals, taking them as soon as they came up.

Further attempts to work stations in the open sea to the south-west of the Bismarck Strait were again frustrated, and as the season was advancing, after making a station off Cape Renard on the mainland, we returned north viâ the Gerlache Straits to King George Island. From here we worked lines of stations across the whaling grounds in the Bransfield Straits, a survey similar to that at South Georgia but on a smaller scale. There was a rich diatom plankton and the young Euphausians occurred in great swarms, giving us much valuable material (Fig. 7).

We now come to perhaps the most difficult piece of work that we had planned: that of running a line of full stations across the Drake Straits from the South Shetlands to Cape Horn. This is a particularly important line, lying as it does between the two great oceans and immediately to the

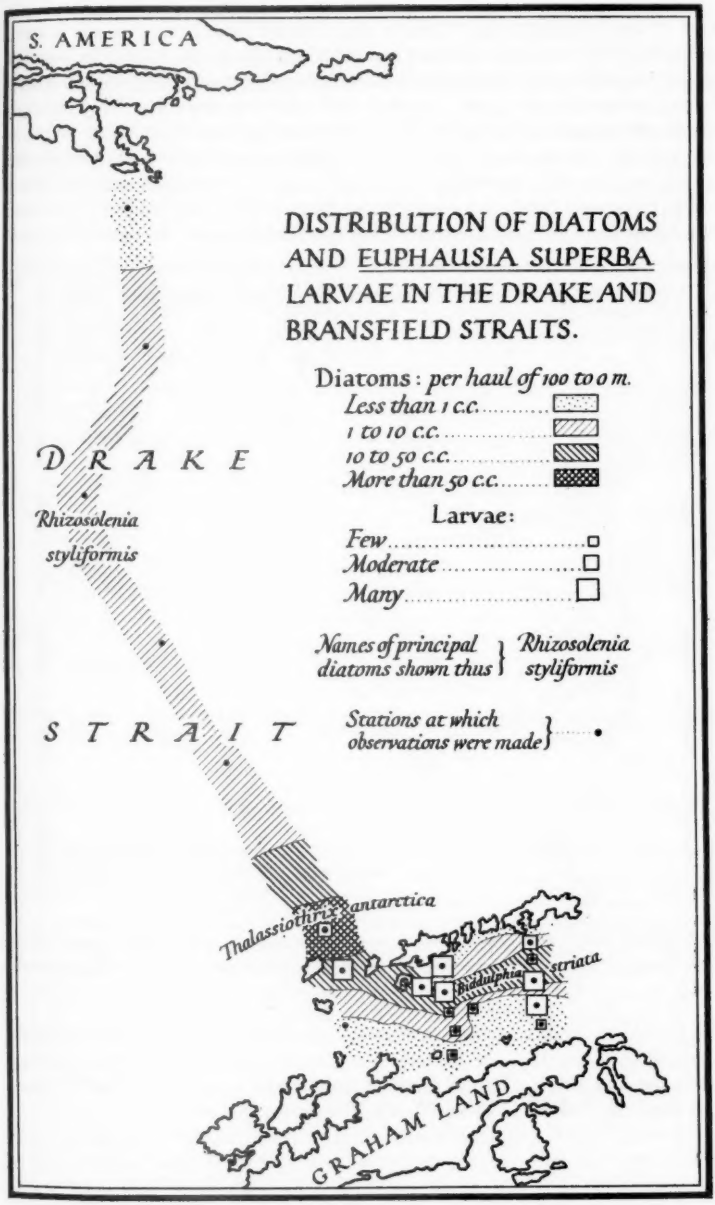

S. AMERICA
DISTRIBUTION OF DIATOMS AND EUPHAUSIA SUPERBA LARVAE IN THE DRAKE AND BRANSFIELD STRAITS.
Diatoms: per haul of 100 to 0 m.
Less than 1 c.c.
1 to 10 c.c.
10 to 50 c.c.
More than 50 c.c.
Larvae:
Few
Moderate
Many
Names of principal diatoms shown thus } Rhizosolenia styliformis
Stations at which observations were made
DRAKE
Rhizosolenia styliformis
STRAIT
Thalassiothrix antarctica
Biddulphia striata
GRAHAM LAND

Fig. 7

west of our whaling area. Usually the weather here is notoriously severe, and with a ship of only auxiliary power it was almost optimistic to hope to get a complete series of observations. However, by good fortune we struck a patch of exceptionally good weather, and with only one short delay through storm we completed the set of six full vertical stations from the bottom to the surface, intermediate stations of towed nets, and a record with the continuous plankton recorder. After sheltering for three days in St. Martin's Cove, Hermite Island, just inside Cape Horn, where the beech forests were a welcome change from the treeless regions farther south, we passed through

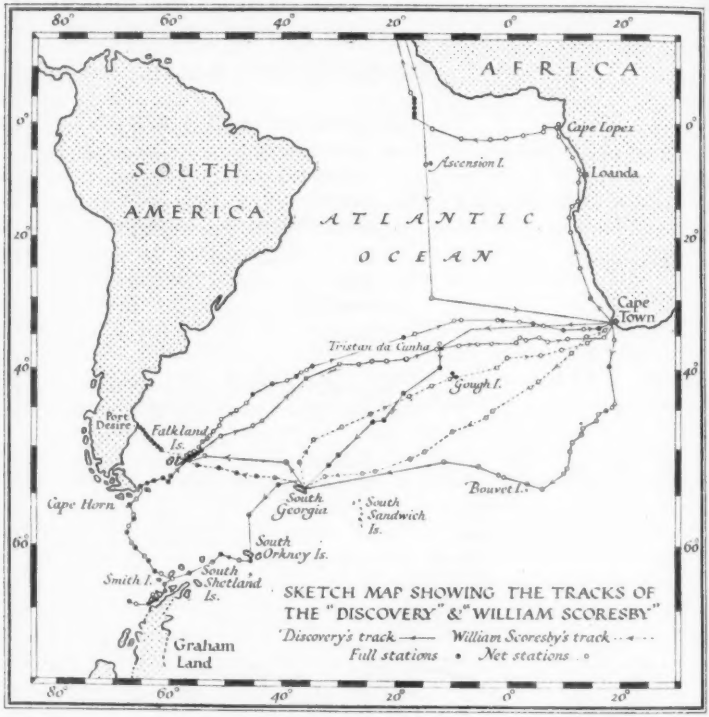


Fig. 8

the Le Maire Strait and ran a further line of stations to the Falkland Islands. Here we met the *William Scoresby* on May 6; in addition to her trawling work she had made a line of stations from South Georgia to the Falklands and from the Falklands to the South American mainland.

The object of the present paper is not to give a narrative of the 1925-27 expedition, but only to give some indication of the nature and objects of the oceanographical side of our work, and particularly of that work in the Dependencies of the Falkland Islands. I will not therefore attempt to describe in any detail the homeward part of the voyage, again viâ South

Africa. The two ships again made lines of tow-net stations across the southern ocean, the *Discovery* viâ Tristan da Cunha and the *William Scoresby* viâ South Georgia and Gough Island, where lines of full stations were worked: at the former to give an idea of conditions at the end of the season to compare with those taken earlier.

The *William Scoresby* returned direct to England to undergo alterations, and the *Discovery* by a longer route up the west coast and into the Gulf of Guinea. Here we wished to investigate the biological and physical conditions of the waters into which the whales migrate to breed, and also to get information at the different whaling stations up the coast about the number, species, and condition of whales taken. We called at Elephant Bay in Southern Angola, St. Paul de Loanda, Port Gentil, the island of Annobon, and finally St. Vincent and home.

Those of us who are in England are all engaged upon working up the material gathered. Mr. Hamilton is making observations for us on a whaling expedition to the South Sandwich Islands, and Messrs. Dilwyn John, Fraser, Marr, Rayner, and Deacon are continuing the work in the south at the shore station and on the *William Scoresby*.

I have said nothing about the hydrographic surveying part of the expedition's work; Commander Chaplin will deal with this. But I would like to repeat what Dr. Kemp has already said when addressing the Challenger Society: that it was a pity, owing to the pressure of oceanographical work, that Commander Chaplin did not have more opportunity for carrying out his work, and that we all admired his energy and the way he took advantage of every possible occasion to do what he could.

As a final word I must state that any results I have hinted at must be taken as being purely provisional; the full details and conclusions will be published in our *Discovery Reports*.

DISCUSSION

Before the paper the PRESIDENT (Col. Sir CHARLES CLOSE) said: To-night Mr. Hardy is going to describe to us the work of the research ship *Discovery* in the Falkland Island Dependencies. I believe that the origin of the expedition is to be found in the fact that the Colonial Office some years ago realized that the revenues of the Falkland Island Dependencies were rapidly increasing owing to the success of the whaling industry, that industry being very largely manned by Norwegians. I think it was Sir Sidney Harmer who suggested that it would be a very good thing if a thoroughly scientific investigation were made into the conditions under which the whaling industry might exist in order that we might not, so to speak, be killing the goose which was laying the golden eggs. It was decided to allot a certain proportion of the revenue derived from the whaling industry to the fitting out and conduct of an expedition to determine scientifically exactly what the conditions were. Scott's old ship the *Discovery* was bought and refitted and a scientific staff was collected, Dr. Stanley Kemp being the Scientific Director, Commander Stenhouse the captain of the ship, and Mr. Hardy Assistant-Director of the scientific side of the work. The expedition started in October 1925 and lasted practically two years, and we shall hope to hear to-night from Mr. Hardy, necessarily somewhat briefly, what work the expedition did and what the results were. I will ask him to read his paper.

Mr. Hardy then read the paper printed above, and a discussion followed.

Dr. STANLEY KEMP: In the first place, I would like to congratulate you very heartily on the fact that you have had Mr. Hardy to listen to to-night and not me, because he has told you of our work a great deal better than I could have done. I think, too, that he has covered the whole field very completely and has not left much for me to say. But I would like to emphasize what he has already impressed upon you—that the work we have been attempting in the *Discovery* is quite different in character from that of any former Antarctic expedition. It has not the same glamour and does not make the same popular appeal; for we are not out for geographical exploration, but are trying—by methods which are relatively prosaic—to introduce into the South methods of study which have proved useful in the North in economic work. I think if we have sufficient time we shall succeed in that, but it must necessarily be quite a long task. It will be many seasons before we have sufficient data to go upon, in order to produce really satisfactory and reliable results.

There is one point which I think might be of interest to the Fellows of this Society; it struck me very much when I was down in the South. It seems to me that South Georgia and the dependencies of the Falkland Islands generally would be a very fine field for research by the more active Fellows of this Society. It is, moreover, within the British Empire, and there does not seem any necessity to travel to foreign countries while such attractive parts of the Empire remain unexplored. Mount Paget, the highest peak in South Georgia, was drifting about the map until Lieut.-Commander Chaplin fixed it not long since, and the topography of the remainder of the island is almost unknown. The coast-line is roughly indicated on our charts, but the interior features are not mapped at all. Although, at the most, it is only some 15 miles in breadth, the island has only been crossed once—by Shackleton and his party on their celebrated return journey from Elephant Island. The opportunities seem to me to be very good. I think Mount Paget is under 9000 feet, but against that may be set the fact that the line of vegetation ceases between 50 and 100 feet above sea-level, so that there is no lack of ice and snow. I would commend exploration of the island to those actively engaged in the work of the Society, for they would, I believe, find it a very promising field.

Sir SIDNEY HARMER: I should like at the outset to refer to a misfortune to the *Discovery* Expedition in that Mr. Hardy—I think I ought to call him Professor Hardy—has recently accepted a professorship at Hull; and this will deprive the Committee of the invaluable services he has rendered. I can best express my opinion of those services by saying that I regard his acceptance of the new post as a disaster to the expedition. If he had done nothing else but invent his continuous plankton-recorder his services would have been very material. Just think of the difference between taking a laborious series of samples from stormy seas—under the greatest possible difficulties—of the plankton, and having a machine which will keep an automatic record of what is happening along the whole of the track without personal supervision. That in itself is a great service. But Mr. Hardy has been extremely helpful in all sorts of other ways. His ingenuity in devising improvements in methods of research and his knowledge of the plankton conditions, and so on, have been invaluable. I am quite sure that every member who is connected with the expedition greatly regrets Mr. Hardy giving up his personal connection with it.

The President has credited me with more than I really deserve. It happened to fall to my lot as an official at the Natural History Museum to examine a number of reports on whaling which, as far as I remember, began to come about 1911, and to present reports to the Trustees of the Museum on them. My reports

were sent to the Colonial Office, and perhaps they had some influence on the ultimate sending out of the *Discovery* Expedition; but credit for drawing up the practical details and formulating a working scheme by which the expedition has been financed is entirely due to the chairman of the *Discovery* Committee, Mr. E. R. Darnley.

I think, if any ordinary person were asked what was the general character of the investigations to be undertaken by an expedition concerned with the whaling industry, he would have a vague idea of going out in a whaling ship to see how whales are caught, and perhaps returning to the whaling station to see how they are cut up and oil and guano prepared. Mr. Hardy has very lucidly explained that the *Discovery* Expedition was planned on a much wider scale. It is necessary to take in practically the whole science of oceanography. Mr. Hardy has referred to the paramount importance of the plankton as the ultimate source of food not only of fishes but even of the greatest marine animals, probably the greatest that ever inhabited this Earth.

Perhaps I may be allowed to make one slight criticism. In his historical survey of the science of oceanography Mr. Hardy did not do justice to William Scoresby the younger, after whom one of our expedition ships is named. In his extraordinary account of the Arctic regions, published in 1820, William Scoresby gave a very clear outline of some of the most important points connected with oceanography as it at present exists. He noticed that the Greenland Whale occurs commonly in places where the water has a peculiar greenish colour. He had an acutely scientific mind and naturally looked to see what was the cause. He found, to his astonishment, that the greenish colour was due to the presence of innumerable small animals which are, in fact, the plankton, or part of it, which Mr. Hardy has been speaking of to-night. He devoted a whole plate in his work to the representation of the organisms he actually found. He was not content with finding plankton and ascertaining that it was the food of the larger animals at sea, but he invented what is known to modern hydrographers as a water-bottle, which he sent down to the depths of the sea for the purpose of bringing up water and taking its temperature. He also examined what we now speak of as the salinity of the water, estimating the quantity of salts present, in exactly the same way that a modern hydrographer does. In fact, to a large extent, William Scoresby had already foreseen some of the most important lines of research that would have to be undertaken by any expedition of the nature of the *Discovery* Expedition.

Then I should like to emphasize the fact that the *Discovery* Expedition is the largest and most important scientific expedition that has left our shores since the time of the *Challenger*. I think I am right in saying that there has been no other large British expedition devoted exclusively to a scientific study of the whole science of oceanography. I am quite sure that all Fellows of this Society will wish every possible success to the work which is under the direction of Dr. Kemp, with, until quite recently, Mr. Hardy as his right-hand man.

The results of the expedition are of very great practical interest. Think of the difference between what was happening a few centuries ago and what is taking place now. Whaling, as a large commercial operation, commenced in about 1600, and in about three hundred years the whalers who went to the Greenland Seas had almost exterminated the Greenland Whale. Whalers have now been at work for about twenty-three years in Antarctic waters, and during that time whales have been caught on a scale never before equalled in the history of the world. Modern whalers are provided with appliances which are much more efficient in every possible way than those used by the old whalers; and if their predecessors could nearly exterminate the Greenland Whale I am afraid it is

more than probable that the modern whaling companies will succeed in reducing the stock of the Antarctic whales to a very low ebb.

I should like to allude to a geographical point which I think is of considerable importance. We know that whales undertake extensive migrations; unfortunately we do not know completely the exact lines taken by those migrations. That is one of the main objects of the expedition. We want to know whether the whales in South Georgia are the same individuals as those found along the West African coast; a view that seems not unlikely. It has been suggested that South Georgia and the South Shetlands are tiny little specks in the surface of the whole world, and that really it hardly matters what is done in so small an area when account is taken of the enormous extent of the oceans of the world. That argument, I believe, is entirely misleading; and if you consider the map you will see that the islands where these extensive whaling operations are going on are particularly well suited to catching, perhaps, all the whales in the southern seas. As Mr. Hardy has pointed out, these whales undertake extensive migrations, both longitudinally and latitudinally. Whichever way they go they have to pass through the comparatively narrow Drake Straits between Cape Horn and the Antarctic continent. Those going from east to west, and those going from south to north would have to pass somewhere in the neighbourhood of South Georgia. I think the fact that the ocean is narrower at that point than at any other part of the Southern Hemisphere is one of the reasons why the whaling stations are so extraordinarily productive in whales. I quite admit that the points which Mr. Hardy has put forward are equally important—namely, the concentration of whale-food round South Georgia, owing to its position in relation to the currents—but it seems to me that the geographical position of the island is also of importance.

We hope steps may be taken in time to save the whales, or at any rate a remnant of them, from the fate which I believe is otherwise inevitable. It is necessary for the Colonial Office to have possession of the main facts in the biology of whales in order to know what remedies are most suitable. There is one remedy which is obvious and perhaps can be applied more than in the past, and that is the prevention of destruction of undersized whales. It is obvious that the size of an animal and its weight bear some relation to the production of oil. If you kill a whale 100 feet in length you get twice as much oil as if you kill one 80 feet in length; similarly, if you kill a whale 80 feet in length you get twice as much oil as if it were only 64 feet long. Therefore it is obvious that if a large proportion of the oil is obtained from small whales, an entirely unnecessary number of whales is being killed. That is one way in which a remedy could be applied.

Mr. Hardy referred in his lecture to "the whale," which I regard as a misleading expression, because it suggests one kind of whale when, as a matter of fact, there are several; and it is necessary to study each particular kind independently. These whales do not have the same habitat; they do not all have the same food; they do not arrive on the whaling ground at the same time. Therefore I venture to suggest it would be better to use the plural rather than the singular expression. I congratulate Mr. Hardy on the interest of the address which he has given, and his colleagues on the very promising nature of the investigations they have made.

Dr. H. R. MILL: As a physical oceanographer, I wish to express my extreme gratification with this paper, not because in my restricted outlook I consider the abundance of whales in the Southern Ocean is of any importance in itself, but the whales have induced people to go out and make observations on the character of the ocean in which they live. In other words, I would use the whale simply as

Stranded berg, Fournier Fjord, Anvers I.

Copper Mountaiu, Anvers I., from Neumayer Channel

In the Neumayer Channel, Palmer Archipelago; Wiencke I. on the right

a bait to induce clever young men to spend their time in acquiring information as to the nature of the oceans and the movements that go on there. In the same way the attainment of the South Pole was a matter of no importance at all except as an inducement to heroic young men to go out and make investigations on their way to it. It was one of the worst calamities that could have happened that the South Pole was discovered prematurely; it would have been better for geography if expeditions had been kept going for another century at least in the effort to reach the Pole. So with the whales in the south. I hope they will not be exterminated, but that their life will be protected so that many expeditions such as that of the *Discovery* will be tempted forth for their investigation.

It is one of the deplorable things in connection with British exploration that great efforts have often been made, but as soon as an efficient staff has been got together with everybody working smoothly, getting to know their job and doing it with facility and completeness, the whole thing has been dropped. Those connected with the expeditions have come home, have been received by this and other societies, a great fuss has been made for a week or two, and then they have been allowed to drift away into other engagements. You find a man who should be exploring the seas or the Polar regions trying to sell motor cars in Bond Street. It is really a tragical farce.

One of the most interesting pieces of work I had to do when I joined the Royal Geographical Society was to assist the Society in equipping for scientific work the *Balæna* and *Active*, which set out from Dundee in 1892 to explore the possibility of whaling in the Antarctic. That expedition, if it did not succeed in its primary object, did call attention to the importance of the region. It introduced Dr. W. S. Bruce to polar seas and led Norwegians, under that magnificent explorer, Carl A. Larsen, to go there in the following year. That led to the opening up of the Ross Sea a few years later, and thus the whole system of exploration and later of modern whaling in the far South was gradually developed. But, as I said, as soon as a scientific expedition attained success it was dissipated to the four winds. After Scott's first expedition the *Discovery* was sent away as a trader to Hudson Bay: happily she was brought back, refitted at great cost and sent on the expedition of which we have heard to-night. There has been no continuity in the past, but I sincerely trust that on this occasion, when the organization has been so complete and the Government departments have taken up the work with such enthusiasm, it will be carried on and developed so that once again, as in the days of the *Challenger*, British oceanographers may lead the world. At the present time they have dropped considerably to the rear. Other nations are doing more efficient work, because they have had more continuity and by more thorough education have kept up a constant supply of well-trained men. It would be most unfortunate, after the *Discovery* has done so much, if these explorers were allowed to drift back into other occupations instead of stimulating the progress of exploration and solving the enormous problems of the far south which are of even more scientific than economic importance.

Commander CHAPLIN, R.N.: I have been asked to supplement Mr. Hardy's remarks by a few observations on the hydrographic surveying. The importance of this side of the expedition lies mainly in the fact that in the course of their business all these whalers must use harbours. The catchers, moreover, in their short but extensive cruises are compelled to cover a large amount of what is at present uncharted sea, and further they are compelled occasionally to take refuge in the nearest known harbour in the event of heavy weather. Their greatest handicap at the moment is, however, the fact that even large islands and lands are charted in many instances as much as 15 miles out, and adjacent lands in opposite directions. It was my aim, therefore, and the guiding principle set

out by the Hydrographer to get as many good geographical positions as I could.

Our actual surveying did not start until we arrived at Tristan. We did nothing very much except take some lines of soundings, the position of the island being now in no doubt and the anchorage indifferent. The cruise after that did not afford any opportunities for surveying until our arrival in South Georgia. In accordance with the main idea I wished first to fix the two ends of South Georgia geographically, and proceeded to carry this out at the first opportunity by going to Undine in the extreme north-west of the island. At that time we had no tender and had to rely on the services of any catcher which happened to be going our way.

After waiting nearly a fortnight and putting in time by triangulating Cumberland Bay and adding many new details to K.E. Cove and some new peaks to the chart, we proceeded to Undine Harbour in the *Don Erneste* of the C.A.D.P. Both Mr. Mathews of the Expedition and Gunner Johannsen of the *Don* were extremely helpful both in suggesting likely harbours and in practical directions. This proved our only camping experience the first year, but it was useful in giving us ideas for future reference. We spent six days ashore ; the sun came out on one day, during which all our sights were taken. The remaining days it rained on and off and blew continually; occasionally it snowed. We managed to fix the latitude and longitude, and we got a true bearing; in addition we made a triangulation, but were handicapped by lack of a boat, the sealer not being able to spare one and not having room for another.

It had been arranged that we should be left ashore for about six days, then called for, and the sealer would do another two days, giving us an opportunity of looking at one or two other bays, and so back. When the sealer appeared at the end of six days it was already dusk and our lamp was lit in the tent; they therefore anchored and left us. It had rained and snowed all day and was blowing an easterly gale. Our tents were all made for snow work and rain did not agree with them. So having stood the rain for a week we were looking forward to a dry bed. The sealers however thought we were all right, seeing our lamp burning, and made no move. We therefore, after waiting a reasonable time, made a large bonfire of tow and paraffin and fired our gun until at last we attracted their attention, when, and for this I give them absolutely full marks, they manned their pram in spite of gale and rain and landed.

Unfortunately for us, although it blew hard ashore and made the tent into a shower-bath whenever it flapped, it was blowing a sight harder in the bay, and the result was we were driven on a lee shore, luckily shingle, and spent about four hours within half a mile of the tent but unable to reach it, soaked and freezing, until we had a lull and pulled off at about 4 a.m. to hot coffee—bless those Norwegians!—and a dry bed. Following that trip we had no surveying except some variation at Stanley, until next year. We did however learn a great deal which helped us the following season, and also induced us to get a new tent in Cape Town—a great boon.

In the second season we arrived earlier, and consequently our opportunities for work were greatly increased. I therefore arranged to leave the ship during a large part of her stay in South Georgia, except occasionally, when I stayed to fix the positions of special soundings. This time besides my assistant Mdm. O'Connor I took an A.B. Smith. We also had a boat (a Norwegian pram) and took passage in our newly arrived *William Scoresby*. Starting with Undine here at the north-western end of the island I completed the survey of the harbour. The weather unfortunately was as bad as usual, and we hardly ever saw the sun. The sounding, however, and some preparation for Else Bay on the other side of

the isthmus occupied our time pretty fully. The *Scoresby* returned in due course, but was unable to wait as I hoped she would to do some outside work.

A spell of sea time now intervened, and we took a couple of lines of deep-sea soundings, etc., getting back to harbour just before Christmas. Early in January we started off again in the *Scoresby*, this time to the other extreme of the island, Larsen Harbour, which proved a very much better place to work in, although not very inviting looking, and we got through a considerable amount of work, and in fact, accomplished all we set out to do, the *Scoresby* again taking us straight back. The further charting of all the harbours used by whalers could now be proceeded with, and this I did by commencing with Leith Harbour and its approaches, Stromness Bay. Through the courtesy of the manager, Mr. Hansen, I had some opportunities of using a catcher for trips along the coast on two occasions, and so was able to fix Cape Buller and Cape Saunders.

The *Discovery* now left for the south, and I had to interrupt my work in South Georgia, leaving several harbours yet to do and of course the intervening coast. We had a most useful day in Borge Harbour, South Orkneys, our next port of call, and having an unusual spell of sunshine shifted the island some 15 miles to the eastward. I should have liked to do some more here, but we only called for coal and had to carry on. Next came Clarence Island. On the way we passed the Ice Island referred to by Hardy; we logged 35 miles from end to end, and could see no limit from the masthead to its length southward. Clarence Island, and in fact the whole group, is many miles north-west of its charted position. The *Meteor* moved O'Brien 10 miles west, and I have now brought Gibbs up to it again. Deception Island, where we spent some days, appears to be one of the few pieces of earth in this region correctly charted. On the way I corrected the position of Simpson Island, near King George Island.

On our way to the south we passed Austin Rocks, and I was able to move them to their correct position, as also Hoseason, Snow, and Smith Islands. Our sights here, being sea sights, were much affected by refraction. We got a rough plan of Melchior Harbour from Capt. Leif Anderson, and with the angles, etc., I was able to take I have managed to make a useful but rough plan. A running survey, also very rough, of Schollaert, de Gerlache, and Neumayer Channels on our passage to and from Lockroy Id. and a rough plan of Discovery Sound completed our work here. We also sounded out Lockroy Id., using Bongrain's plan as a basis. In addition I have managed to put the Kendall Rocks in their place and charted a New Rock, a high one, off Deception. Also a few additional soundings were taken at Admiralty Bay Anchorage.

I need hardly say that what has been done is but a fractional part of what remains to be done; even if only the necessary bits are carried out the whole would take a lifetime. By the way, on our way back we nearly shifted Cape Horn; but not with the ship. We also got sights at Annobon, Elephant Bay and Port Gentil, and have left those places where they were. A considerable number of the usual odd jobs were done, like putting in new topographical details in the places we visited, mainly W/T masts and War Memorials, both relics of the War.

Mr. A. C. HARDY: I thank those who have spoken for the kind remarks they have made. I am very sorry to be leaving the *Discovery* expedition and its work, and particularly the pleasure of working under the leadership of Dr. Kemp. But I can assure Dr. Mill that I am not resigning my interest in the work of the expedition. I am leaving only because, having been offered the chair of zoology in the new University College of Hull, I believe it is possible to found a school of biological oceanography in that port, which not only was once a great centre of the old British whaling industry, but is, with Grimsby, perhaps the most important centre of the fishing industry in the world. I think we ought to have a

department of biological oceanography there, where men may fit themselves to go out on such expeditions as that of the *Discovery*, and where researches into the many problems of the North Sea may be carried out. I hope the future will see the endowment of several research fellowships there.

Sir Sidney Harmer is right: the name of William Scoresby should certainly be included in a history of whaling research, but in the short time at my disposal I thought I would begin my brief sketch of the development of oceanography at about 1850.

The PRESIDENT: We all have reason to thank Mr. Hardy for the account he has given of the expedition. His is a type of lecture with which we are not very familiar, and it is all the more interesting on that account. We hope that the results will be thoroughly worked out. I understand that there is something like five years' work already accumulated, and if the expedition goes out again no doubt there will be still more to do. The expedition itself was obviously managed with the greatest success, and we must congratulate all those connected with it, not forgetting the Colonial Office. Public departments come in for a good many hard knocks, and sometimes justifiably, but in this instance a public department has taken the opportunity to do a fine piece of work for science and also for the Empire.

The suggestion that the Society should take up the serious exploration of South Georgia is one which I am sure would appeal to the Council and ought to be considered seriously later. I hope that one of these days we may find that a properly equipped expedition has been sent out. In conclusion, I again thank Mr. Hardy for his excellent lecture.

The "Discovery" at Port Lockroy, Wiencke I.; Gentoo Penguins in foreground

Cape Renard (2624 feet), Graham Land, with Booth Wandel I. beyond

Gentoo Penguins, Wiencke I., Palmer Archipelago

Mount William, Anvers I., from Port Lockroy, Wiencke I.

THE GILBERT MAP OF c. 1582–3

THE sale of early books and MSS. from the Library of Lord Leconfield, which took place at Sotheby's on April 23–24 of this year, included an unusual number of documents of historical and geographical interest—many of them relating to America—and the prices realized were phenomenally high. The greater number seem to have come from the Library of Henry Percy, Ninth Earl of Northumberland, an important figure of the early seventeenth century, from whom Lord Leconfield is descended. The Earl was a friend of Raleigh and closely associated with the enterprises of the early American pioneers, being in particular a member of the Virginia Company. It is to Virginia that some of the most remarkable of the recently sold treasures relate, as for instance the earliest MS. of Strachey's 'History of Travel into Virginia Britannia' (first printed by the Hakluyt Society in 1849), and the excessively rare printed works of Rich ('Newes from Virginia,' 1610) and John Smith ('True Relation,' 1608). On the other hand, New England was represented by such rarities as Brereton's 'Brief and True Relation,' 1602, the first English publication on that part of the continent, and Rosier's 'True relation' of Weymouth's voyage of 1605; each in two issues. Besides plates from De Bey the Strachey MS. had, inserted, a coloured copy of Smith's rare printed map of Virginia, 1612. Several MS. maps were also sold, including a finely coloured map of Guiana on vellum, evidently drawn to illustrate Raleigh's voyage of 1595–97.

From the geographical point of view, however, the most interesting item was no doubt the hitherto undescribed MS. Map of North America and the Arctic Regions, bearing at the side the inscription "Humfray Gylbert knight his charte," which we reproduce at the end of the present number by kind permission of the purchaser, Dr. Rosenbach.* A comparison of the inscription just quoted with previously known signatures of Gilbert leaves little doubt that it is in his autograph, and that the map must have been drawn, at latest, in 1583, the year in which he sailed on his last and fatal voyage to Newfoundland. This conclusion is confirmed by the watermark of the paper used—a bunch of grapes on a shield with the name of the Troyes maker J. Gouault below. This mark was by no means common, and appears to have had but a short currency, being quoted by Briquet only from the period 1579–86, while we have found it also in De Jode's Atlas of 1578. This signature would seem to refer to the possession rather than to the drawing of the map, for lower down we find the letters T. S., followed by the word *fecit*, and with a sort of cabalistic sign between, somewhat resembling the symbol used by astronomers for the planet Mercury. As mentioned in the sale catalogue, this proves to have been the personal mark adopted by the famous Dr. John Dee, Mathematician and Astrologer, as is to be found in his work 'Monas Hieroglyphica,' printed at Antwerp in 1564. Dee is known to have been greatly interested in geography and overseas voyages, and to have been closely associated with the projects for colonization and discovery which were exercising the minds of so many at the

*We are also much indebted to Lord Leconfield and Messrs. Sotheby for kindly lending us the photographic negative of the map taken before the sale for the reproduction given in the sale catalogue. Our reproduction has been enlarged from this negative, but is still somewhat smaller than the original, which measures 24½ in. by 19¾ in.

time. A MS. map by him, dated 1580, is preserved at the British Museum, and was reproduced in vol 8 of Messrs. Maclehose's reprint of Hakluyt's 'Principal Navigations.' It embraces somewhat the same area as the "Gilbert" map, namely, the North Atlantic (with the adjacent parts of Europe), all America north of the Equator, and the Arctic Regions up to the Pole; having obviously been drawn to illustrate projects for Northern and Western discovery. It is on a carefully constructed projection, and while closely following Mercator for most of North America, shows the extreme northern parts, with the Arctic lands adjoining, after a fashion not exactly matched in previously known contemporary maps. It is therefore interesting to find that the "Gilbert" map exactly reproduces this picture, and thus bears further evidence of Dee's association with its construction. Moreover, it seems possible that this very map is referred to by Dee in a list of his MS. writings, to be found at the British Museum, to which our attention has been called by Miss E. G. R. Taylor. In this list the map is thus described: "Hemisphæri Borealis geographica, atque Hydrographica descriptio: longe a vulgatis chartis diversa: Anglis quibusdam versus Atlantidis Septentrionalia litora, navigationem instituentibus dono data, An. 1583."

It will be remembered that Gilbert's thoughts had for some years been turned towards the discovery of a sea-route to China by the north-west. As early as 1566 he had applied for privileges "concerning the discoveringe of a passage by the north to go to Cataia," supporting his claim by a 'Discourse' on the possibility of a north-west passage, but that nothing then resulted owing to the clash of rival claims. The views put forward in the 'Discourse' (eventually printed in 1576) differ in many ways from those hinted at in the Dee-Gilbert map, which appears to represent a later development. Its later date is supported by a comparison with the well-known map of Michael Lok, printed by Hakluyt in 1582 to accompany his 'Divers Voyages touching the Discovery of America,' Lok being also a champion of Western discovery. A characteristic feature of Lok's map is the representation of the "Mare de Verrazana," based on the discoveries of the Florentine navigator Verrazzano in 1524, which were first made accessible to English readers by Hakluyt's translation in the work of 1582.* This feature is reproduced in the Dee-Gilbert map, and the fact that Lok's map was printed while the other remained in MS. is a strong reason for believing the latter to have copied from Lok's, and not *vice versâ*. In any case this is but a subordinate feature in the Dee-Gilbert map, the important part of which is the representation of the more northern parts of North America, with the waterways supposed to give the much-desired access to the Pacific Ocean across the heart of the Continent as we now know it.

It is impossible to lay down the precise parts taken by Dee and Gilbert in the preparation of their joint map, but even if Dee were mainly responsible there can be little doubt that it closely reflects the geographical ideas of Gilbert when planning his last voyage. The close association of the two men is shown by the quotation from Dee's diary for 10 September 1580, printed in Sotheby's sale catalogue, which refers to the grant to him by Gilbert of

*This well-known map has been reproduced many times, *e.g.* in vol 7 of Maclehose's reprint of Hakluyt's 'Principal Navigations,' p. 368.

"royaltyes of discovery all to the north above the parallell of the 50th degree of latitude." The special interest of the newly discovered map lies in the help which it gives to an understanding of the views and objects of the first founders of the British Empire—objects which seem to have been imperfectly understood in some quarters. These questions are fully dealt with in the following article by Mr. R. P. Bishop, who has for some time been a keen student of early British colonial enterprise.

LESSONS OF THE GILBERT MAP

By R. P. BISHOP

THE newly discovered Gilbert "Charte" resembles in certain important respects the map of Michael Lok published by Hakluyt in 1582; and as internal evidence shows Gilbert's to be the later of the two, it would appear to have been drawn within a year or so of his death in 1583. As most of Gilbert's maps and plans were reported to have perished with him, the "charte" is of especial value in enabling us to understand the motives which led him to Newfoundland in 1583, and subsequently towards the mainland coast where one of his ships was wrecked off Sable Island.

The standard book of reference on Gilbert is the 'Life' published in 1911 by W. G. Gosling, of St. Johns, Newfoundland. Mr. Gosling pays full tribute to the Founder of English Colonization, but additional evidence is now available to show that Gilbert's ideas have not, in recent times, been clearly understood. Part of this evidence appeared some time ago in a somewhat uncommon book by William Cotton: 'An Elizabethan Guild of the City of Exeter,' published in 1873. The Merchant Adventurers of Exeter, who made a small contribution towards Gilbert's voyage of 1583, were bound by oath not to "dysclose the secret talke . . . which maybe hurtfull to the said Companye," and their records throw a good deal of light on certain aspects of affairs not generally made public. From these records it appears that the voyage was "pretended to the westren parte of America," and Gilbert's chart, it seems, explained the way to get there.

The chart differs very materially from the sketch published in 1576 with Gilbert's 'Discourse of a Discoverie for a New Passage to Cataia,' and an explanation of these differences reveals a good deal of secret history. The 'Discourse' was inspired by the large Ortelius world-map of 1564, on which Gilbert's sketch was based;* the original Ortelius map came to light not long ago, and the part dealing with the Atlantic coast of America is now reproduced (opp. p. 304), as the map is still very little known. An analysis of this remarkable map enables us to interpret Gilbert's 'Discourse' very clearly.

The eastern extremity of America, including 'Canada,' is separated from the mainland, a conception apparently derived from the maps—or rather charts—of Lopo and Diego Homem, who were Portuguese. In the Homem maps the north shore of the St. Lawrence appears as a series of islands, with passages between leading to an open sea beyond—the Mare Leparamantium. On the Atlantic coast appears a remarkable gulf or bay which can be identified with

*Gilbert's sketch-map is reproduced in vol 7 of Maclehose's edition of Hakluyt, p. 176.

the Bay of Fundy; this is greatly exaggerated in size, badly oriented and a long way from Cape Breton, but the detail it shows is evidently the result of a careful survey.

Diego Homem shows the St. Lawrence intact, and apart from the insular character of its northern shore it agrees with the maps which show the results of Cartier's voyages, but the Bay of Fundy is shown as very close to the south shore—not of the Gulf but of the River St. Lawrence itself a long way from the mouth. The charts are obviously compiled from separate surveys which were not "tied" together. Lopo Homem deliberately distorts the St. Lawrence to show a connection with Minas Basin, at the head of the Bay of Fundy; and the most plausible explanation is that the man who made such a careful survey of the Bay and of all its minor inlets was also aware of the existence of the waters beyond the narrow isthmus which joins Nova Scotia with the mainland. These he probably took to be the "other sea," and so the idea may have arisen that there was a passage in the neighbourhood. Lopo Homem's representation of this passage was followed, with some modifications, by Ortelius, who named the bay the Golfo de las Gamas; and it is this name, supported by independent evidence, which enables us to interpret Gilbert's ideas.

The name seems to have arisen indirectly from the River of Gamas, reported by Estevam Gomez, a Portuguese pilot, who, after turning back from the Straits of Magellan in 1520, was sent by Charles V to search for a similar passage in the north in 1525, and apparently returned under the impression that something of the kind existed. Gilbert laid a good deal of stress on the fact that the Gomez discoveries had been hushed up, and contemporary accounts give a similar impression when compared with later versions: if this is correct the information which Gomez acquired cannot have been fully and correctly shown in the maps of his day. The Homem maps, drawn by fellow-countrymen several years later, were probably more in accordance with Gomez' ideas, and Gilbert would very naturally assume that Ortelius, working on the same lines, had interpreted these ideas correctly.

The name Gamas became applied to a river which appeared on the maps, but without a name, as soon as Gomez returned, but whether this was the river to which Gomez originally applied the name is not quite clear. The unnamed river, apparently the Penobscot, soon became confused with the Bay of Fundy as in the Ortelius map, and the passage indicated here, coupled with the specific use of a name which Gomez had used, undoubtedly accounts for Gilbert's interest in the coast south-west of Cape Breton. The same river, which can be identified by names on adjoining parts of the coast, also became known as the Rio Grande, or the River of Norumbega; and Mercator in 1569, by placing it west of Claudia Island, appeared to identify it with Verrazzano's river, probably the Hudson. Several maps show this river connecting with the St. Lawrence, and Lok's map of 1582 is one of the number: Gilbert's "charte" follows suit, and the conventional "city" of Norumbega, copied from Mercator, helps to identify the district where John Walker, in the service of Sir Humphrey Gilbert, discovered a silver-mine in 1580. The "New Map" of 1600 revived the idea of a passage through the continent in this direction, but under the original name, the River of Guamas, and this idea exercised a considerable influence on the history of America in the following century.

The voyage undertaken about the same time as that of Gomez by Verrazzano, a Florentine in the service of France, led to the belief in a narrow isthmus between the Atlantic and Pacific Oceans, and in order to understand the Elizabethan projects of half a century later we must realize that these two voyages eventually gave rise to rival theories of a passage through the continent. Gilbert's chart is perhaps the only document which combines the two.

That Gilbert personally adopted the Gomez theory is clear from his use of the Ortelius chart, and from the following passages in the 'Discourse:'

> Also this discovery hath bene divers times heretofore by others both offered, attempted, and performed.
>
> It hath been offered by Stephan Gomes unto Carolus the fift Emperour, in the yeere of our Lord God 1527, as Alphonso Ullva testifieth in the story of Carolus life: who would have set him forth in it (as the story mentioneth) if the great want of money, by reason of his long warres had not caused him to surcease the same.
>
> And the king of Portugall fearing lest the Emperour would have persevered in this his enterprise, gave him to leave the matter unattempted, the summe of 350000 crownes: and it is to be thought that the king of Portugall would not have given to the Emperour such summes of money for egges in mooneshine.

Gilbert drew a glowing picture of the wealth of the East, and of the benefit to be derived from opening up a trade in that direction, but their influence on the subsequent fate of the American continent makes his colonization proposals a matter of more absorbing interest. These appear in the following passage:

> Moreover we might from all the aforesaid places [*i.e.* the rich countries of Eastern Asia] have a yeerely returne, inhabiting for our staple some convenient place of America, about Sierra Nevada, or some other part, whereas it shal seeme best for the shortning of the voyage.*

Gilbert's 'Discourse' was written in June 1566, and in November he petitioned the Crown for a licence to explore the North-West Passage and take possession of vacant lands in that direction. This was rejected as a result of the objections of the Muscovy Company, who held a monopoly to the East, West and North. There, apparently, the matter rested until 1574, when "certen gents in ye Weste partes" sought authority for a "new navigacion" to "lands beyond the equinoctial." The petition is endorsed with the names of Gilbert, Peckham, Carleill, Grenville "and others," and a draft commission in favour of Grenville and some of his relatives is still in existence. In his recent book 'Sir John Hawkins,' Dr. Williamson points out that the date of 1590 generally attributed to this Commission is quite erroneous, and that the document is evidently a reply to the above petition. It grants permission to enter the Pacific and trade with "the Great Cham"—the Khan of Cathay; and as Grenville also proposed to search for the North-West Passage from the Pacific side it is evident that the "lands beyond the equinoctial" were at any rate very useful in helping to outwit the Muscovy Company. All the "gents" referred to eventually took part in projects for a passage through America,

*Ortelius shows the Sierra Nevada on the west side of the continent between 42° and 45° N. Lat..

but the hand of Gilbert seems very clear in this particular instance. The evidence of John Oxenham before the Inquisition, given in Mrs. Nuttall's 'New Light on Drake,' shows that Grenville actually received his charter and that he made extensive preparations to act on it and to plant a colony, eventually in the Pacific. The idea of a colony in this ocean was first outlined in Gilbert's 'Discourse.'

Dr. Williamson points out that the document printed on p. 8 of the Hakluyt Society's volume on Frobisher, which suggests that the Strait of Anian should be approached from the west and not from the east, is endorsed "Mr. Grenville's voyage"in Burghley's hand; so it is now clear that Drake's plan of taking possession of the Pacific coast and of searching for the North-West Passage on that side was mainly the idea of Gilbert and Grenville.

In 1574–5 the Crown brought pressure to bear on the Muscovy Company, and Frobisher was given permission to attempt the passage, making three voyages in 1576–7–8. His cousin, Gascoyne, printed Gilbert's 'Discourse' in 1576, and this, according to the preface, was done without the author's permission; but it is clear that the material had been brought up to date after 1569.

By 1577 events were moving fast, and Dr. Dee coined the expression "British Empire" in his memorial on navigation dedicated to Sir Christopher Hatton, whose crest was a Golden Hind. A few days before Drake's departure from Plymouth Gilbert submitted a further discourse which explained "How Her Majesty may annoy the King of Spain." He suggested that Letters Patent should be issued "to discover and explore some strange place," that with these as a pretext the so-called explorers should destroy rival fishing fleets off Newfoundland, and on their return they should be arrested and kept in custody by some complaisant vice-admiral—presumably Champernowne of Devon—until the fuss had blown over.

The famous Letters Patent to Gilbert were issued in June 1578, and the care with which they are worded makes one suspect that the pretext lay not so much in the issue of the letters patent as in the suggestion of annoying the King of Spain. The scheme was probably intended as a device to circumvent the Muscovy Company, and to avoid a clash with the Frobisher expeditions, which were being carried out by the "Company of Cathay." Gilbert's expedition was practically in readiness, and on August 5 Dr. Dee recorded that Mr. Reynolds "took leave of me as he passed towards Dartmouth to go with Sir Umfry Gilbert toward Hocheleya"—evidently the Houchelaga of the Ortelius map. What happened after this is not very clear, but it is evident that there was a good deal of disagreement among the leaders. The expedition —or part of it, including Gilbert and possibly Raleigh—fell foul of the forces of the King of Spain after all, and the "annoyance" was unfortunately on the wrong side. This crippled Gilbert for some time, and he was not able to set out again until 1583.

Meanwhile Michael Lok, who had been ruined by the Frobisher voyages, had come forward with a rival suggestion. The Company of Cathay, of which he was President, had sought for rights by the North, West and South, and this perhaps led him to resuscitate the idea of the Verrazzano isthmus, which seemed to offer access to the Pacific in a more congenial clime than Frobisher's Straits. Lok's idea was strongly supported by Hakluyt, who published his

map at a very opportune moment in 1582, and this was, perhaps, the first map to refer to Drake's voyage of circumnavigation.

Gilbert's theories were by this time distinctly out of date, or rather out of fashion, for they were revived later. Mercator in 1569 and Ortelius in 1570 had published maps in which America extended far to the north on more conventional lines; and what was more important, the St. Lawrence was shown as a river without any opening to the west; this of course completely upset the Gilbert-Gomez theories. Lok perhaps conceded a point in connecting the River of Gamas or Norumbega with the St. Lawrence, but this really did Gilbert little good, as a passage farther west was still barred in this direction. This must have put Gilbert in a very difficult position, for it would be difficult to raise any more money without adopting new theories altogether; and unless some sort of a passage were shown his project might lose favour with the Crown, especially if, as Hayes' narrative published by Hakluyt clearly states, Gilbert had really undertaken the "Westerne Discovery of America" when his Letters Patent were granted.* Judging from his newly found chart, he boldly accepted Lok's challenge, adopted his topography for the St. Lawrence and Norumbega, and then extended the St. Lawrence to the Gulf of California, running another branch out to the northern shore of the continent. On the other hand, he was ready to concede Lok the "Mare de Verazana," and this still had access to the Pacific, but through one of Lok's own inlets in a most inconvenient position.

The revival of Gilbert's prospects may very possibly have been due to this ingenious "charte." His friend Sir George Peckham and other leading Catholics, who were anxious to emigrate, purchased certain concessions, and Walsingham lent his support to the idea of a joint expedition. A certain amount of money was raised by means of the "Southampton Company"—from which the members of the Muscovy Company were absolutely barred—and Walsingham suggested that other cities too should lend their support. Bristol, under the influence of Hakluyt, suggested an expedition under Carleill, who was Walsingham's son-in-law, but this was allowed to lapse, at any rate for the time being.

The Bristol correspondence is all recorded by Hakluyt, but the Exeter records, which are difficult of access, are worth quoting at some length, as printed by Mr. Cotton :

> 4th Jan. 1583.† At this Courte ther is a lre reade from the right wor' Sr Fraunces Walsingham, Knight, chief Secretary to her Matie, dated the viijth day of December 1582, directed to the Maior of Exeter, touching the voyage pretended to the westren parte of America by Sir Humfrye Gilbert, Knight, and others.
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> Also ther is an other lre reade from the right wor' Sir George Peckham, Knight, dated the xiiijth December 1582, directed also to the said Maio' of Exeter, touching the saide matter.
>
> And this Courte being especiallie called to understande what money everie one of this Companye will disburse and adventure in and aboute the settinge forth of certen shippinge to the saide parties of America; and the Governo'

*Maclehose's Hakluyt, vol. viii, p. 39.

†In modern reckoning, as given by Mr. Cotton. In the old style it would be 1582.

moving the Companye thereunto and declared the greate benefite and commoditie thereof ensuying: The whole generallitie doo lyke well of the saide voyage and wysh good successe therunto, and woulde be glade to adventure and set forth shipping thether: But considering the tyme of the yeare to be ffarr spente for preparation of shippinge and provision for suche a voyage, they mynde to respecte thereupon this yeare; and the next yeare as they shall see success therein, they will be glade to adventure thether and doo anything for the furtherance thereof.

Memorandu: that the xith daye of January 1583, one Olyver Manwayringe, servant to the right wo' Sr George Peckham, Knight, being authorized for that purpose, came in and declared the pretence and order of a voyage pretended to the westren parte of America, and the grate benefite and commoditie that may ensue thereof, as well to the whole realme as to the Adventurers that waye: And shewed forth certen lres patente for the assurance of the benefitte of the said Adventurers, and a booke touching the description and order of the saide pretended voyage: Whereupon the Governor moved the Companye to set forth certen shipping, and to be Adventurers that waye: But forasmoche as ther is two lrs directed to the Maio' of Exon: one from the right wo' Sr Fraunces Walsingham, Knight, chief Secretary to her Matie, and thother from the saide Sr George Peckham touching the saide matter, the Governo' Consulls, and Companye thought it good that the Maio' and Aldermen his bretheren should conferr as well for the answering of their saide wo' lres, as also to take order for shipping and adventuring in the saide voyage.

The western part of America, twice referred to, becomes clear in the light of Gilbert's charte, and doubly clear when this is connected with his 'Discourse' and with contemporary history. In 1566 Gilbert had proposed to plant a colony on the Pacific coast, near the Sierra Nevada, as a base for trade with the East, and in the meantime many projects had been broached and several attempts had been made to carry out the idea. Drake had taken possession of the country in 1579, and there were strong hopes, which persisted for centuries, of reaching it by the shorter route. Drake's name of Nova Albion had not yet, as far as we know, appeared on any maps, but a few years later it appeared on several maps in the neighbourhood of the present international boundary. Michael Lok's map of 1582 was apparently the first to show Drake's voyage, and it is a somewhat significant fact that the Sierra Nevada here appeared in the same position that Nova Albion occupied later on. In Gilbert's "charte" the "Sierra Nevada," still parallel to the coast, lies in a different direction, but they are in the same latitude, and here again it seems that the agreement must be intentional.

The search for the North-West Passage was partly inspired by the hope of reaching the Pacific without encroaching on the Spanish sphere of influence; in 1582 England was still at peace with Spain, and the hope of solving the difficulty by peaceful means may have accounted for the absence of Nova Albion on the Lok and Gilbert maps. But in an appeal to reason all available evidence would be necessary, and this may account for the Sierra Nevada, indicating where Gilbert had first proposed to settle, being placed in the position which Drake had actually reached.

The ways and means proposed were many and various, but there may be some contemporary justification for Gilbert's idea of reaching the Gulf of

California by way of the Rio S. Pedro. The Hondius map of the Drake and Cavendish voyages shows a possible opening at the head of the Gulf, and Hessel Gerritsz refers in 1612 to the Spanish belief that the English Captain Thomas Cavendish was well acquainted with this passage: to prevent its use King Philip, it was said, had ordered a strong fort to be built on the northern coast of Mar Vermejo, as Gilbert names the Gulf of California. In describing Drake's intercourse with the Indians of California Hakluyt has some significant marginal notes: "Chaines like those of Canada" and "the like they did in Hochelaga."

All these ideas now appear very strange, and shallow critics are apt to scoff at their originators, but the best cure for this state of mind is to traverse an unexplored country with an incomplete and possibly misleading map. But these strange beliefs in a passage to, or the proximity of, the Pacific were a potent force in the settlement of America. Without them Virginia would have been abandoned and the fate of the continent might have been very different.

But the germ of oversea dominion had been planted once for all, and though ways and means became confused nothing could quite obscure the clearer vision. To this we owe the Letters Patent of 1578, reissued later to Raleigh, but it is in Gilbert's original proposal that we inhabit for our staple some convenient place "about Sierra Nevada" that we find the first clear concept of New England in America.

LOST OASES OF THE LIBYAN DESERT

By W. J. HARDING KING

IN the map attached to the first of Dr. Ball's three papers on " Problems of the Libyan Desert " (*G.J.*, 70 (1927)) he marks certain areas in this desert within which he considers that unknown wells and oases may possibly be found, and he shows others where he considers that it is impossible for them to exist, as the surface relief of the desert and his contours of static underground water-levels show that artesian wells would be ineffectual, and as " there can, of course, be here no question of local rainfall as a source for the water in the ' wells ' " (*G.J.*, 70 (1927), p. 122).

It is with considerable diffidence that I venture to differ, even on a minor point, from such an eminent authority as Dr. Ball, on a subject that he has made so thoroughly his own as the water supply of the Libyan Desert; but I find it impossible to agree with his view that wells, and even oases, cannot exist in the Libyan Desert from rainfall alone.

In selecting the points upon which to base his static contours, Dr. Ball excludes some small water sources such as Nakheil and 'Ain Amur, on the ground that " percolation from occasional local rainfall seems to be the only possible source of supply " (*G.J.*, 70 (1927), p. 109). The little oasis of 'Ain Amur lies on the top of " the argillaceous exogyra series and below the overlying Danian limestone "* about 460 metres above sea-level, near the top of a cliff that bounds the limestone plateau between Kharga and Dakhla Oases. As this limestone is almost impervious to water, the rainfall can only find its way down into the ground through fissures in this rock, and these are not numerous. If a water source can exist in such a situation as this, near the top of a cliff, surely one would be possible on the level ground below, where the rain falls on porous sandstone?

The rainfall of this district amounts probably to less than a quarter of an inch a year; but the Nubian sandstone, that covers so much of this desert, is a porous rock into which water will rapidly sink. Veins of clay are by no means uncommon in this formation and often extend over wide areas: Mr. H. J. Ll. Beadnell, in Kharga oasis, found old lacustrine deposits of a clayey nature covering hundreds of square miles,† and probably beds of a similar extent exist elsewhere in this desert. If even so small an amount as one-hundredth of an inch of rain were to sink into the sandstone in the course of a year, and accumulate by being held up by an underground layer of clay, the total amount stored up in this way in the course of a single year, under a square mile of desert, would amount to 145,000 gallons, sufficient to supply a fairly strong desert well.

But one-hundredth of an inch would probably be greatly exceeded on porous ground on the borders of the Sudan or near the Mediterranean coast. If one of these layers of clay, of the size of the old lake deposits in Kharga oasis, happened to take a basin-like form, the water would tend to gravitate towards the lowest point, and in the course of time a large underground reservoir might accumulate, sufficient to supply a group of wells such as those in the Sheb district. If the surface contours were suitable, even a

*H. J. Ll. Beadnell, ' An Egyptian Oasis,' p. 166.

†H. J. Ll. Beadnell, *op. cit.*, pp. 110–122.

small lake might be formed. An oasis of some size might develop in a district of this kind, and for a time might continue in a flourishing condition. But if more water were drawn from the wells than sank into the ground from the slight rainfall, in time the accumulation of even centuries would begin to dry up, and the oasis eventually would have to be partly, or entirely, abandoned. This very likely is the history of many small " lost oases " in the Libyan Desert.

A small sanded-up site—Bu Gerara—that I found (*G.J.*, 42, p. 456) near the road that runs from Assiut to Dakhla oasis is a case in point. It had evidently been irrigated by a well, sunk through the soil for about 10 feet down to a layer of indurated clay below. When I found it, only the foundations of a few small buildings remained and the well was completely choked with sand. The sand however just above the clay was found, when the well was excavated, to be distinctly damp, and the presence of palm trunks built into the mud-brick walls showed that formerly the well had supplied enough water to irrigate a small oasis. This little place lay at least 200 metres above the static underground water-level of Dr. Ball's map.

Herr Paul Borchardt, whose work in connection with the geography of the Libyan Desert is insufficiently known in this country, tells me that Gerara in Arabic means a locality where rain-water is held up in this way by an impervious stratum some distance below the surface of the soil. The natives say that places of this description are not uncommon.

There are a number of native reports of " lost oases " said to be located in the area where Dr. Ball's map shows them to be impossible, if their water-supply is to be derived from wells ; but I think they may exist as the result of accumulated rainfall, though they may now be deserted. Among these is that extremely elusive oasis known as Zerzura.

Dr. Ball states that the earliest mention of Zerzura that he had been able to trace is that of Sir Gardner Wilkinson, in 1835 (*G.J.*, 70, p. 120). But there is a much older reference to it than this, contained in an old Arabic fifteenth-century MS. called ' The Book of Treasures.'* These " Books of Treasure," of which there are several known, give directions for finding riches supposed to be buried in various localities, some of which are perfectly well known, but the identity of others cannot now be established—assuming them ever to have existed. As a guide to intending explorers data of this kind are unreliable, but that does not in the least affect the fact that Zerzura oasis was known as far back as the fifteenth century.

Dr. Ball, at " Pottery Hill," found what had evidently been an enormous water depôt, consisting of " Zeers," or pottery jars for holding water, that he concluded to have been a water dump, used by some blacks who, about 1770 according to information given by Hassan Effendi to Ascherson, made repeated raids into Dakhla oasis from the south-west (*G.J.*, 70, p. 122). Dr. Ball's ingenious derivation of the name Zerzura from the same root as " Zeer," and his suggestion that Zerzura should be translated to mean " The water depôt of the Blacks " (*G.J.*, 70, p. 123), is obviously untenable, unless it can be shown that the raiding blacks had been using the same depôt for three hundred years before 1770. His derivation however may hold

*W. J. Harding King, ' Mysteries of the Libyan Desert,' pp. 52–56.

good to give Zerzura the meaning of " the potteries," or " the oasis where ' Zeers ' are made "—especially as rough earthenware has for ages been made in the Egyptian oases.* All the native traditions describe Zerzura as an oasis, but a descriptive title like " the potteries " might easily be applied to more than one place, and this may account for the conflicting character of the traditions of Zerzura.

To a great extent I can confirm the accuracy of the information referred to that was given by Hassan Effendi to Ascherson. The stone quarry that he mentions exists, about 15 miles south-west of Mut, in Dakhla oasis, and is worked by the natives for millstones. Also within a few miles of the quarry I found two " 'alems " (land marks) placed some distance apart along an old disused road that eventually led apparently to Owanat. These two " 'alems," allowing for native exaggeration, may have been the two " pillars " mentioned by Hassan Effendi. I heard, too, from his descendants, who were still living in Mut at the time of my visit, of two weapons that had been picked up in the desert. I saw neither, but from the descriptions that were given to me, one was evidently a throwing-knife and the other a spear, or javelin, with an iron shaft. Spears of this kind are still carried by the Tuareg.

Wilkinson's tradition that Zerzura lies " about five or six days west of the road from El Hez to Farafra," and that " Gebabo, another *Wah*, lies six days beyond this to the west," if plotted together as a continuous straight route is hopelessly wrong. Dr. Ball, by amending the bearing from west to south-west, makes the information correspond more closely with the facts (*G.J.*, 70, p. 121). But even with this correction the road is far too short. The first part of this information, however, taken by itself, only as far as Zerzura, corresponds reasonably well with some that I collected that placed a large " hattia " two days west of Iddaila (*G.J.*, 42, p. 282).

Dr. Ball refers to a stone temple that I heard had been found eighteen hours' journey to the west of Gedida, in Dakhla oasis, and which I was told was called Zerzura, and suggests that this may have been only that well-known temple the Deir El Hagar on the western edge of Dakhla oasis. But the man who told me he had found this building gave me the information shortly after he had been with me on a visit to the Deir El Hagar, and if the two places had been identical it is absolutely certain that he would have said so.

What was evidently one of the main caravan roads of the desert—though it has apparently been disused for centuries—runs from Dakhla oasis for about 375 miles to Owanat. Assuming that a large road of this length was impossible without an intermediate well, I concluded from various indications that an oasis, containing olive trees, existed on this road ten or eleven days from Dakhla (*G.J.*, 45, p. 153). I have since heard that Herr Paul Borchardt received definite information that one was to be found eleven days along this road from Dakhla, and that it was called Owana, or Zerzura. This information fits in well with mine and also with a rumour that Comyn heard that 160 miles from Bir Terfawi was a rich country.† The place, if

*H. J. Ll. Beadnell, *op. cit.*, pp. 113–119.

†' Service and Sport in the Sudan,' p. 298.

it exists, must be off the south-east corner of Gilf Kebir, about midway between the routes of Prince Kemal el Din of 1925 and 1926; but it could easily have been overlooked from them, especially if it lay in a depression. Whether an oasis exists there now or not, any one with any practical experience of camel travelling I think will agree that a main caravan route cannot have a stretch of 375 miles without a well, and that water from some source must have been found somewhere there, at the time when the road was in use.

The great broken plateau, or mountain range, known as the Gilf Kebir, I saw, and roughly mapped, from Gebel El Bayed, the only point on my route from which it was visible in 1909.* Its name—"the big Gilf"—rather suggests that there must be a second Gilf—the Gilf Sgheir, or little Gilf—not very far away. Names such as these usually run in couples. It may perhaps be worth while for future travellers to make inquiries on this point.

The sand-dunes of the Libyan Desert run in long narrow lines that seem to have the power of collecting nearly all the sand in the neighbourhood. To account for this peculiarity I suggested (*G.J.*, 51, p. 31) that sand-grains blown on to a dune became incorporated with it by falling into the ripples that covered its surface, where, being sheltered from the wind, they came to rest and so were added to the mass of the dune. It has also been suggested that this process is assisted by the "shepherding" effect of winds from a slightly abnormal direction that drive the sand-grains from the surrounding desert into the long line of the dune belt. Dr. Ball, in criticizing these views, puts forward a most ingenious electrical theory to the effect that the collecting power of the dunes is due to the attraction that they exert upon the electrified sand-grains flying through the air, owing to their having a conducting surface at zero potential. Without in any way questioning the theoretical correctness of his view, I find it difficult to see that this electrical attraction would have much *practical* effect. The pull on the sand-grains from this cause is admittedly only a question of centimetres (*G.J.*, 70, p. 218), against which must be set the transporting power of the furious gales that cause the sandstorms. Nor can I see that this electrical attraction would have any effect in keeping a dune together, for as soon as a sand-grain touched a dune it would be earthed. It would appear in fact to have rather the opposite effect: for, as Dr. Ball points out, uncharged grains might rise from a dune to meet the electrified grains as they approached it, and then they would be exposed to the full force of the wind.

Dr. Ball states that the surface contours are absolutely conclusive that no dried-up branch of the Nile exists in the Libyan Desert (*G.J.*, 70, p. 30). But he omits all mention of a river-bed known as the Wadi El Fardi, reported to run through Erbayana, Buseima and Taiserbo, across the Jalo-Kufra road and on through Jarabub, Siwa and Bahrein into the Qattara depression and on to the Nile. So far as this Wadi runs over the contoured part of Dr. Ball's map, the surface contours seem ideal, until the neighbourhood of the Nile is reached. Its further course is then barred by a ridge lying to the west of Wadi Natrun. My information as to how the Wadi El Fardi

*'Mysteries of the Libyan Desert,' p. 115.

reached the Nile, after leaving the Qattara depression, was contradictory and perhaps misleading, unless the elevation of this ridge should have been due to one of the recent earth-movements that Dr. Ball considers might possibly have occurred in this desert (*G.J.*, 70, p. 32). But whether it reached the Nile or not, there seems to be no reason why it should not have run into the Qattara depression. If it did, it would account for a good deal of the water to be found there.

The salt swamps that cover so much of the floor of this depression in the winter months are so slushy as to be impassable. But in the summer they appear to parch out to such an extent as to be practically dry—at any rate at the western end of the depression where the Wadi El Fardi, assuming it to exist, enters the depression.* It would be interesting to know the actual difference between the levels of the water-table during the summer and winter seasons at this point. A slushy swamp implies the water-level is practically at the surface of the soil, but for a saline swamp to dry completely out would apparently necessitate a fall from the surface-level of a metre at least. Assuming that the underground reservoir from which the water comes remains at the same level, it is difficult to believe that such a large fall can be due solely to the *difference* between the evaporation during the winter and summer months, if the moisture, as Dr. Ball suggests, is being renewed, even partially, from below.

Dr. Ball points out that any variation in the rainfall in the districts from which the artesian supply of the Egyptian oases comes is damped out before it reaches them ; but it by no means follows that this is the case with water flowing through the narrow bed of a river. There is a district in the Algerian Sahara known as El Wad Suf (*G.J.*, 53, p. 46) that is irrigated by water flowing through just such a dried-up watercourse as the Wadi El Fardi is stated to be, and here there is a regular seasonable rise and fall in the level of the water that flows below the surface of the sand. Should there be a similar fluctuation in the water-level in the neighbourhood of Siwa that is too great to be accounted for by evaporation, it would be a rather strong argument in favour of the existence of the Wadi El Fardi.

The following facts in support of Dr. Ball's view that the depressions in the Libyan Desert are due—at any rate in part—to the action of the rootlets of the vegetation disintegrating the limestone, may not be without interest. While crossing once some biggish dunes in the Algerian Sahara, I passed a small tuft of grass, and, as I found it quite firmly rooted in the sand, halted my caravan to examine the roots. The sand was so loose that I could easily excavate it with my hands. I found that, in addition to the roots that descended more or less vertically into the dune, it had thrown off a number of horizontal creeping rootstocks—rhizomes—that radiated in all directions from the tuft, running a few inches below the surface of the sand. I traced out one of these rhizomes for a considerable distance without reaching its end. I did not actually measure the length that I excavated, but it certainly was not less than 25 yards. All along its length, at frequent intervals, it threw down thick branches vertically to an unknown depth into the sand—

*'A Report on the Oasis of Siva,' by T. B. Hohler (Cairo, 1900), p. 9.

and this was only one of many similar rhizomes that radiated from that tuft of grass.

The effect that such a root-system would have in disintegrating the rock with which it came in contact would obviously be very great: moreover, this process would be especially effective in a limestone district, for the rootlets exude an acid sap that will actually dissolve the rock and convert it into plant food, and this secretion is especially effective against carbonate of lime.*

The total length of the root-systems of plants is much greater than is generally supposed. The roots of an ordinary oat plant, when placed together end to end, were found in one case to have totalled 150 yards in length.† The plant that springs from a single grain of wheat has a much greater root development that may total as much as half a mile. But even these measurements must be almost negligible when compared with the root-system of that desert grass, whose total length cannot have been less than 50 miles. No other tuft of grass showed above the surface anywhere in the neighbourhood, so the whole of that stupendous underground growth must have been required to support a single puny little clump of leaves about 18 inches in height.

*'Advanced Agriculture,' by H. J. Webb, p. 129, 1914 edition.
†'Agricultural Botany,' by John Percival, p. 29, 1918 edition.

REMARKS ON "LOST" OASES OF THE LIBYAN DESERT

By JOHN BALL, O.B.E., D.SC.

IT is, of course, only by a slip of the pen that Mr. Harding King imputes to me, in the second paragraph of the foregoing paper, the "view that wells, and even oases, cannot exist in the Libyan Desert from rainfall alone;" for in his very next paragraph he names two water-sources for which, as he correctly states, I have considered that "percolation from local rainfall seems to be the only possible source of supply." As a matter of fact, I have attributed to local* rainfall, not only the water-sources of Ain Amur, Dungul, Nakheil, Kurkur, Arkenu, and Owenat, but also all the wells of the littoral portion of the desert (*G.J.* 70 (1927), 109, 117).

As Mr. Harding King does not mention any water-source to which he thinks I have wrongly attributed an artesian origin, I imagine that his views on this matter differ from mine only in that he believes that wells or oases fed by local rainfall may exist in the south-western portion of the desert, within the areas where, as indicated by the colouring of my map in the *G.J.* for July 1927, I consider there is no possibility of obtaining artesian water at reasonable depths. Mr. Harding King's argument is that if occasional rainfalls yielding less than a quarter of an inch a year suffice to maintain a permanent water-source like Ain Amur, where the surface-rock is fissured Danian limestone underlain by impermeable clays, then even smaller amounts of rainfall should be able to maintain permanent springs or wells in the south-western parts of the desert, because of the greater porosity of the Nubian sandstone which forms the surface-rock there, as compared with limestone. But this I think is a mistake. Under the conditions which prevail over the greater part of the Libyan Desert, the porosity of the Nubian sandstone *hinders*, rather than promotes, the accumulation of underground water-supplies from the local rainfall.

To make this point quite clear, let us first consider what is likely to happen when, after one or more rainless years, a thunderstorm occurs, yielding, let us say, half an inch of rain, in a locality where jointed and fissured limestone strata, 100 feet or so in thickness, form the uppermost rocks of a plateau and are underlain by impermeable clays. Being only slightly porous, the surface-limestones will absorb very little of the rain which falls on them; most of the rainfall will first run off into any depressions which may exist on the plateau-surface, and will then make its way down joints and fissures by more or less zigzag courses, penetrating sooner or later to the level of the underlying clays, where, being arrested in its downward progress and protected from evaporation, it will accumulate; and the accumulation may persist for long periods unless tapped by springs or wells. If there is synclinal folding of the strata, the clays in the trough of the syncline will form an underground basin wherein the water will collect, and the folding will very likely have accentuated the jointing and fissuring of the limestone. The well-known solvent action of meteoric waters on limestones will also come into play, and may result not only in a gradual widening of the fissures, but possibly also in the formation of underground cavities above the clays, thus both facilitating the downward

*The qualification "local" is an important one; for of course *all* the wells and springs of the deserts ultimately depend on the rainfall of some area or other.

progress of the waters and providing additional space for their underground accumulation.

I think it is by a process similar to that outlined above that the water-supplies of Ain Amur, Dungul, Nakheil, and Kurkur are maintained. At the first three of these places the synclines are truncated by escarpments, producing springs high up on the scarp-faces; while at Kurkur the synclinal basin lies some little distance back from the face, and the water is tapped by shallow wells sunk in a depression of the plateau-surface. It is a remarkable fact, that although the four water-sources just mentioned are separated from each other by long distances, they all occur at the same geological horizon—the base of the Danian limestone. This latter rock is typically rather soft, approximating to chalk in places, easily eroded, and perhaps particularly liable to jointing and fissuring.

Now let us consider a corresponding case where the uppermost hundred feet or so of the rocks consist of Nubian sandstone instead of limestone, and let us suppose the sandstone to contain 20 per cent. of pores.* If there has been no rain for a year or more, the uppermost beds of the sandstone, probably even the entire thickness, will be dry when the storm occurs, and much of the rain will be at once absorbed by the thirsty rocks on which it falls. The whole half-inch of rainfall will only suffice to saturate a $2\frac{1}{2}$-inch thickness of the sandstone; capillary action will render the further downward progress of the water very slow in the body of the rock, and the bulk of the water being thus left very near the surface, subsequent evaporation in the hot dry air of the desert will be rapid. Even if the sandstone is much jointed and fissured, lateral absorption will go on at the faces of the joints and fissures, and possibly not a drop of the rain may ever penetrate to the underlying clays. Further, owing to the insoluble nature of the sandstone, there will be no tendency for the cracks to be widened by solution, or for underground cavities to be formed.

In the south-western portion of the Egyptian Libyan Desert the conditions are in general even more unfavourable to the production of springs and wells from local rainfall than the above comparison would indicate. For in this region there is a marked absence of interbedded clays, such as are widespread in the northern parts of Kharga Oasis.† In all the long distance of about 500 miles from Beris *via* Sheb and Bir Terfawi to Owenat, I observed practically no clays; and in two shafts which have recently been sunk by Mr. Beadnell between the last-mentioned two places, no clay-beds were passed through, though one of the shafts descended to 160 feet below the surface.

The Owenat region is exceptional, not only in that its mountain-masses give rise to somewhat more frequent and heavier local rainfalls than occur in the lower country, but also in that the sandstones are there underlain by impermeable igneous rocks, which hold up the water almost as effectively as clays.

*In experiments made by Sir William Willcocks on twelve cubes of Nubian sandstone used for building purposes, the mean specific gravity of the samples was 1·88, and the mean absorption of water was 10·3 per cent. by weight, or 19·4 per cent. by volume. See Willcocks and Craig's 'Egyptian Irrigation,' Third Edition (London 1913), p. 845.

†I here refer to the "impermeable grey shales" which underlie the surface-water sandstones of Mr. Beadnell ('An Egyptian Oasis,' p. 125), not to the "lacustrine" deposits mentioned by Mr. Harding King; the latter are purely superficial deposits of geologically recent origin, not interbedded in the sandstones.

But even at Owenat the permanent springs are confined to a few situations where the form of the ground and the geological structure are specially favourable to their formation.

There is a growing mass of evidence that within geologically recent times the climate of the Libyan Desert was a moister one than it is at present; and possibly the same may be true in some measure for the historical period. I therefore agree with Mr. Harding King in considering it quite likely that, in certain parts of the desert at least, springs, wells, or oases may have formerly existed and are now dried up. The deep shaft at Al Tundaba, on the Kharga railway line, mentioned by Mr. Beadnell,* is doubtless a case of this kind, and the sanded-up well discovered by Mr. Harding King at Bu Gerara another. I may add that within the last few years quite a number of shallow depressions containing acacia trees have been found in the northern parts of the Libyan Desert, especially between the Oasis of Baharia and the Qattara Depression. The trees, which number hundreds in all, are many of them in a flourishing condition, and are evidently nourished by local rainfall; and though there are no wells or springs there now, these depressions may once have been sites of human settlement. But it is important to note that all these depressions and the dried-up wells of Al Tundaba and the Bu Garara are, like Ain Amur, Dungul, Nakheil, Kurkur, and the coastal wells, situated in the limestone country of the north-eastern part of the desert. There is as yet no evidence, so far as I know, of any well or spring maintained by local rainfall existing or ever having existed in the sandstone-country which forms the south-western desert of Egypt, except in the mountainous tract around Arkenu and Owenat; and from the considerations I have mentioned above, it would appear unlikely that any "lost" oasis owing its origin to local rainfall can await discovery in that region.

In drawing attention to the interesting fact that a place called "Zerzura" is mentioned in a fifteenth-century Arabic MS., Mr. Harding King has made an even more useful contribution to the subject of "lost" oases than he imagined; for on reading his paper† and endeavouring to trace the MS. to which he refers, I discovered that "Zerzura" is also mentioned in a still earlier Arabic MS., and that the texts of both manuscripts have actually been published by the Egyptian Government.

The earlier of the two manuscripts is a copy made in A.D. 1447 of a description of the Faiyum which had been written two hundred years earlier (about A.D. 1246) by Osman el Nabulsi, a Syrian emir who was appointed administrator of that province by Negm el Din, the last sultan but one of the Ayyubide dynasty.‡ El Nabulsi states that Zerzura was one of a number of villages already abandoned in his time, situated in the neighbourhood of a canal called

*'An Egyptian Oasis' (London 1909), p. 29.

†I had inadvertently overlooked his earlier statement to the same effect on p. 53 of his book ('Mysteries of the Libyan Desert,' 1925).

‡For the Arabic text of Nabulsi's work, with an introduction in French by Dr. B. Moritz Bey, see 'Description du Faiyoum au VII^me^ Siècle de l'Hégire' (Publications de la Bibliothèque Khédiviale, vol 11, Cairo 1899). An analysis of the contents is given by Ahmed Zeki Bey under the title of "Une Description Arabe du Fayum" in the *Bulletin de la Société Khédiviale de Géographie*, Cinquième Série, No. 5, 1899, pp. 253–5. Concerning the identification of the places mentioned by Nabulsi, see "Répertoire Géo-

the Bahr Tanabtawayh which entered the Birket el Qarun from the south. Amongst the other abandoned villages enumerated by Nabulsi are Qasr Qarun and El Rayan; and as the name Zerzura stands between these two in the list, it may be conjectured that Zerzura lay somewhere to the north of the Wadi Rayan.

The later MS., which is the one alluded to by Mr. Harding King, is called 'The Book of Hidden Pearls,' and is the work of an unknown writer of the fifteenth century. It is of a totally different character from the preceding, being essentially a book of magic, telling stories of hidden treasure at about four hundred different sites in Egypt, most of which are stated to be difficult of access and guarded by jinn, and instructing the would-be seeker after wealth how he may get over the various obstacles, and render the jinn powerless by means of incantations and fumigations. Both the Arabic text of the MS. and a French translation of it by Ahmed Bey Kamal have been published.* In an extremely interesting introduction to the French translation, Ahmed Bey Kamal remarks that there are many works of this class in Arabic literature, and that the belief in the existence of buried treasure has been prevalent in Morocco and Egypt ever since the Arab conquest. He states that this book has been the cause of more damage to the ancient Egyptian monuments than all the ravages of war and the hand of time; and that the late Professor Maspero sanctioned its translation and publication in the hope that when copies of it were procurable at the cost of a few francs, instead of being almost priceless rarities, credulous persons would cease to attach any importance to its contents, and further damage to the monuments would thus be avoided.

The paragraph in the book which contains the mention of "Zerzura" is numbered 369, and headed "The City of Wardabaha,"† and reads as follows:

> "In the city of Wardabaha, situated behind the citadel of el Suri, you will see palms, vines, and springs. Penetrate into the wadi and pursue your way up it; you will find another wadi running westwards between two mountains. From this last wadi starts a road which will lead you to the city of Zerzura,‡ of which you will find the door closed; this city is white like a pigeon, and on the door of it is carved a bird. Take with your hand the key in the beak of the bird, then open the door of the city. Enter, and there you will find great riches, also the king and queen sleeping in their castle. Do not approach them, but take the treasure."

None of the places mentioned in the above-quoted paragraph can now be identified with certainty.§ But bearing in mind that old ruins have always

graphique de la Province du Fayyôum d'après le Kitâb Târîkh al-Fayyôum d'An Nboulsô," by G. Salmon, in the *Bulletin de l'Institut Française d'Archéologie Orientale*, vol 1 (Cairo 1901), pp. 29–72, with map.

*The publication is in two volumes, the first containing the Arabic text, and the second the French translation. The full title of the latter volume is 'Livre des Perles Enfouies et du Mystère Précieux au Sujet des Indications des Cachettes, des Trouvailles et Trésors," publié et traduit par Ahmed Bey Kamal,' Cairo 1907.

†In the French translation (p. 209) this name is given as "Warde," but the Arabic volume (p. 159) gives "Wardabaha."

‡The French translation gives "Farzourah;" but this is evidently a misprint. The word is clearly "Zerzura" in the Arabic volume.

§Daressy, "Indications Topographiques du Livre des Perles Enfouies," *Bulletin de l'Institut Français d'Archéologie Orientale*, vol 14 (Cairo 1918), p. 16.

been favourite scenes for romances concerning buried treasure, I think we need have little hesitation in concluding that this particular story is woven around the ruins of the abandoned village mentioned by Nabulsi, somewhere near the western border of the Faiyum and north of the Wadi Rayan, and that the circumstance that the old name of the village signified a starling or other small bird is responsible for the introduction of the words "white like a pigeon" and of the "carved bird" into the story.

There now arises the question as to whether the "Zerzura" of the two manuscripts has any connection with the traditional "lost" oasis of the same name. As bearing on this question, I may remark that I have lately been told that legends of a "lost" oasis called Zerzura are not confined to Egypt, but, like stories of hidden treasure, are current far to the west; and many of the magicians who have recited the incantations and burned incense at tombs and temples in Egypt, after the manner prescribed in the 'Book of Hidden Pearls,' have been Moors. I had not hitherto thought of any connection between stories of buried treasure and traditions of lost oases; one does not usually hear or speak of them together, since stories of buried treasure, with their directions for the use of magic, are of course not believed in except by very credulous persons, while the traditions of lost oases, which in their present form include no reference to the magical arts, have not seemed incredible even to educated and practical-minded travellers. But when one thinks of it, the finding of a lost oasis, with plenty of water and grazing, would be worth quite as much to desert Arabs as the finding of a concealed hoard of gold or silver would be to dwellers in towns. A shrewd story-teller would naturally adapt the details of his tale to the outlook on life of his auditors; and he would have the less difficulty in doing this with the "Zerzura" story in the 'Book of Hidden Pearls,' in that the scene of this romance, with its directions about following tracks up wadis, is already laid in the desert, while the story itself is one of the comparatively few in the book which contain no reference to magical rites. The retention of the name "Zerzura" is easily explicable by its lack of resemblance to any existing place-name; and it would be easier for the narrator to retain it than to invent a new designation.

The wide extent over which the tradition of Zerzura is spread in Northern Africa, and the great discrepancies between the various statements as to its whereabouts, are easily explainable on the supposition that some hundreds of years ago a Moorish magician or story-teller, who had practised his profession in Egypt and was familiar with the 'Book of Hidden Pearls,' went back to Morocco by way of the desert, attaching himself to successive caravans trading between the various settlements on his route, and telling the story of "Zerzura" at a number of scattered places, substituting water-sources and vegetation for the treasure of the original story, and otherwise varying the details for the better entertainment of his auditors, but always retaining the same name for the mythical oasis. The story told at the different spots would be handed down, doubtless with slight alterations, from generation to generation. Wandering Arabs losing their way for a time would be prone to imagine that mirages seen in the distance were the waters and trees which they had heard existed in the lost oasis; and on rejoining their fellow-tribesmen they would relate to them, in perfect good faith, how they had really *seen* Zerzura.

If we believe, as I think the above considerations justify us in doing, that the tradition of the lost oasis of Zerzura is merely a variation of one of the old treasure-stories, told at different places long ago and handed down with small alteration through the centuries, we must conclude that the "lost" oasis of Zerzura has no more real existence than the philosopher's stone; and we can only regret that the mention of the name "Zerzura" in the ancient manuscripts was not discovered earlier.

The dismissal of Zerzura as a purely mythical oasis does not, of course, imply that there may not be oases in the Libyan Desert hitherto unvisited by European travellers, and in consequence not shown on our present maps; still less does it imply that there may not exist dried-up wells or springs along caravan routes which have fallen into disuse. But once we cut out Zerzura, I doubt if there exists anywhere in the Libyan Desert a permanent water-source which is altogether unknown to the Arabs. It should be remembered that Arkenu and Owenat, though they have been styled "lost oases," were places already well known to the Arab guide who showed Hassanein Bey the way to them; they were only "lost" in the sense that until Hassanein Bey organized and undertook his wonderful journey, equipped with scientific instruments for establishing the positions of places along his route, geographers could not feel sure of their existence, let alone place them satisfactorily on a map or form a correct idea of them and their surroundings.

Mr. Harding King's idea of an "olive-oasis" existing between Dakhla and Owenat must, I think, be regarded as untenable. Borchardt's "Owana or Sersura" is, from the position in which he shows it on his map of 1916,* obviously Owenat itself; and the distance of eleven days figured on Borchardt's map between Dakhla and "Owana" agrees well with the "10 or 11 days" at which Mr. Harding King would place his "olive-oasis." Had any oasis existed in the neighbourhood of the south-eastern corner of the Gilf Kebir ("Great Scarp"), I cannot think that so acute an observer as Prince Kemal el Din Hussein would have failed to find some indication of it in his journey round the eastern and southern faces of the scarp in 1926. (Mr. Harding King is evidently under the impression that the Prince's track cut across the south-eastern corner of the plateau; but that is not the case; the route was round the foot of the scarp.)† The distance of 375 miles between Dakhla and Owenat could easily be traversed in the ten or eleven days mentioned by Mr. Harding King as required to reach his "olive-oasis"; this only implies about 35 miles a a day, a rate which is frequently achieved by Arab camel caravans which have to travel over long waterless stretches of the desert. In this connection it is impossible not to sympathize with Mr. Harding King in the bad luck which, in the shape of faulty water-tanks and bad conduct on the part of his guide, attended his exploratory journey south-westwards from Dakhla in 1911.‡ He

*'Mittheilungen aus den deutschen Schutzgebieten,' Band 29, Berlin 1916.

†The misconception doubtless arose from the circumstance that the 700-metre contour shown on my map does not indicate the real shape of the plateau, because the contour happens to run well to the east of the foot of the scarp, while the top of the plateau is still below the 1000-metre level which corresponds to the next higher contour of the layers adopted.

‡*G.J.* 39 (1912), 137; see also 'Mysteries of the Libyan Desert' (1925), p. 165.

was going almost straight for Owenat, although he never came within sight of it; had he been able to penetrate the desert in that direction for another 150 miles or so as he had intended, he would inevitably have discovered Owenat and himself identified his "olive-oasis" with it.

The question of the existence of an old river-bed called the Wadi el Fardi (or Farig, Fareg, Farigh, or Faregh; they all mean the same thing, an "empty" or waterless wadi), which Mr. Harding King records as reported to run from Tibesti through Ribiana, Buseima, and Taiserbo, across the Jalo–Kufra road and on through Jaghbub, Siwa and Bahrein into the Qattara Depression and on to the Nile,* cannot be very thoroughly discussed at present, because the vastly greater portion of the area through which it is supposed to run has not yet been trodden by any European. But from all the evidence bearing on the question which I have been able to gather, I am strongly inclined to believe that no such old river-bed exists. I think it is a similar case to that of the "Bahr bela ma" which was formerly supposed to course through the Egyptian portion of the Libyan Desert; in other words, that the name "Wadi el Fardi," or one of its equivalents, is applied by the Arabs of the Libyan Desert to a number of waterless depressions having no connection with each other. I will briefly mention the principal grounds on which I base this opinion.

No Arab would be likely to speak of a wadi which ran through places like Kufra, Jaghbub, and Siwa, with their plentiful supplies of excellent water, as the "Wadi Fardi," or "empty wadi;" the very name implies that there is no good water or grazing there.

If the "Wadi el Fardi" follows anything like the course indicated by Mr. Harding King, it must have been crossed by Rohlfs on his way from Bengazi to Kufra in 1879, by Mrs. Forbes and Hassanein Bey in 1920, and again by the last-named traveller on his second journey between Jalo and Kufra in 1923. But the evidence of all the three is against Mr. Harding King's supposition. Rohlfs† records that at about 150 kilometres southward of Bir Butaffal (that is, at a point about on the supposed course of Mr. Harding King's "Wadi el Fardi") he reached what the Arabs said was a wadi called "Behar-bela-ma;" but he remarks that he himself could not see anything at the place even remotely resembling a wadi; and the wadi was said to run to Sella, an oasis some 250 miles to the west-north-west, thus following a course very different from that of the "Wadi el Fardi" of Mr. Harding King. Mrs. Forbes states that she and Hassanein Bey passed, likewise at about 150 kilometres southward of Bir Butaffal, a place which the Arabs said was the "Wadi el Farig;" but she says emphatically that she could not herself see the slightest depression of any kind.‡ In describing his latest journey of 1923, Hassanein Bey records§ the crossing of a slight depression in or near this same locality, but does not mention any name for it.

Mr. Harding King supposes the "Wadi el Fardi" to run through Buseima and Taiserbo; but the map of Rohlfs, who travelled between these two places

*See his maps in the *G.J.* for September 1913 and at the end of 'Mysteries of the Libyan Desert,' 1925.

†'Kufra' (Leipzig 1881), p. 263 and map at end.

‡'The Secret of the Sahara' (London 1921), p. 132.

§'The Lost Oases' (London 1925), p. 129.

in 1879, shows them as entirely separate depressions with a broad tract of "serir" desert between them.*

On his map of 1916† Borchardt shows a "Wadi el Faregh" following a very similar course to the "Wadi el Fardi" depicted on Mr. Harding King's map in the *G.J.* for September 1913. But in drawing up his map Borchardt evidently made use of Mr. Harding King's previous publications, copying, for instance, Mr. Harding King's route south-west of Dakhla from the latter's map in the *G.J.* for 1912; and he may very possibly have relied on Mr. Harding King as his authority for the continuity of the "Wadi el Faregh," in which case, of course, Borchardt's map affords no independent evidence on the question.

Rohlfs' map of Tripoli and Barka‡ shows a "Wadi Fareg" debouching into the Gulf of Sidra a little to the south of Jedabia; this is probably the same "Wadi Farig" which was crossed by Mrs. Forbes and Hassanein Bey between Jedabya and Jalo in 1920;§ it lies, of course, far to the north of the supposed "Wadi el Fardi" of Mr. Harding King, and has no relation to it; but I mention it as indicating that the name "Wadi Fareg" has been applied, like its equivalent "Bahr-bela-ma," to depressions in the desert-surface which are quite separate from each other.

Of that part of the supposed course of the "Wadi el Fardi" which lies eastward of Jaghbub, I can speak with some personal knowledge, having been engaged in military reconnaissance work in that region during the war.‖ There is a chain of depressions between Jaghbub and Siwa, most of them containing salt-marshes and salt-lakes. Some of these depressions are connected together into groups by passages through which water may recently have flowed from one to another; but between the different groups there are broad tracts of higher-lying broken stony ground through which no traces of an ancient river-bed have been found. Between the Siwa depression and that of Areg, and again between that of Areg and Bahrein, are long stretches of stony ground, likewise without any visible trace of a former connecting channel. If we cut out Bahrein from Mr. Harding King's list of places through which the wadi is supposed to run, and examine the easier and more direct course from Siwa to the Qattara Depression, we meet with a similar difficulty; the intervening higher ground shows no trace of any old river-bed across it. If any ancient river had flowed into the Qattara Depression we might expect to find traces of fluviatile deposits within the depression; but no such traces have been found. The slope of the floor of the eastern half of the Qattara Depression is upwards towards the east; between the eastern end of the depression and the Wadi Natrun is some 60 miles of high-lying desert, without a trace of any old river-bed; and the Wadi Natrun is separated from the Delta by some 20 miles or so of fairly high-lying desert, again without any indication of an old channel passing through it.

*See the large-scale map in Rohlfs' 'Kufra,' Leipzig 1881.

†'Mittheilungen aus den deutschen Schutzgebieten,' Band 29, Berlin 1916.

‡Rohlfs' 'Kufra,' Leipzig 1881.

§'The Secret of the Sahara' (London 1921), pp. 53–55.

‖The results of this reconnaissance work were incorporated in the Sollum–Jaghbub–Moghara sheet of the 1:500,000 map of Egypt published by the Survey of Egypt in 1917 and still in print.

No exact measurements have been made of the seasonal fluctuations of water-level in Siwa and the Qattara Depression. But I believe they are trifling, and certainly very much less than the metre which Mr. Harding King assumes. The lakes in Siwa are so shallow that a lowering of their level by only a few inches during the summer leads to a great shrinkage of area. I remember that on returning from a patrol to the east of Siwa during the war, we halted our cars alongside the large salt-lake which lies some 15 miles east of Siwa village, in the hope of getting a welcome bathe in its lovely-looking blue waters; but we waded out for quite a long distance without the water reaching above our ankles. In the salt-marshes I doubt if there is any measurable change of true water-level at all. The marshes are covered with a crust of mixed sand and salt, which crystallizes with a ridged surface resembling that of a gently troubled sea. In the summer the rate of evaporation exceeds that of capillary ascent and the crust gets hard on the surface. In winter, when evaporation is less, capillary attraction from the watery layers below, aided by occasional small amounts of local rainfall, keeps the crust softer. The whole fluctuation in water-content is, I think, concentrated in the uppermost foot or so of the "sabakha," as the mixture of salt and sand is called. Where the depth of the marsh is small, the hardening of the crust in summer may of course make travel over it practicable. But where the depth of the marsh is considerable, the hardening of the crust constitutes a positive danger; for the hardened surface will bear but little weight, and camels or cars venturing on it may easily sink through into the salty quagmire below.

INTERNATIONAL GEOGRAPHICAL CONGRESS, CAMBRIDGE, 1928

WITH the approval of H.M. Government and the various bodies concerned, the International Geographical Congress of 1928, organized by the British National Committee, was held at Cambridge from July 18 to 25. Certain preliminary ceremonies took place in London, where the Commission on the Carte du Monde held its Conference.

On Thursday, July 12, an office of the International Geographical Union was opened in the Council Room of the Royal Geographical Society where delegates of the Union and Members of the Congress could notify their arrival, book accommodation at Cambridge, and obtain general information, special railway tickets, etc. A selection of books and maps from the Society's collection was laid out for inspection in the Reading Room and Map Store, and all the available sheets of the Carte du Monde were on view in the Map Room. The cases were temporarily removed from the centre of this room, which formed a very pleasant and convenient meeting-place for the Commission of the Carte du Monde. The first Conference of this body was held on Saturday morning, July 14, under the Presidency of General Vacchelli, the chief business at this meeting being the consideration of what appeared on the agenda as the British Delegates' proposals, but which were actually the proposals made by the Central Bureau after correspondence on the questions raised at Cairo. A decision was arrived at on all points; the report, drawn up by the Secretary of the Central Bureau, Major D. A. Hutchison, was passed at the second meeting of the Conference on Monday afternoon, July 16, for subsequent presentation to the International Geographical Congress at Cambridge. The Commission concluded its labours with the consideration of a few additional points raised by delegates; and a telegram of greetings was sent by the Conference to Prof. A. Penck, the initiator of this international undertaking. A full account of the International Map Conference will be published in the *Geographical Journal* for October.

On Saturday morning the President, General Vacchelli, and Executive Committee of the International Geographical Union had the honour of being received by H.M. the King. In the afternoon the President (Colonel Sir Charles Close) and Council of the Royal Geographical Society held a reception at Lowther Lodge to which all members of the Geographical Congress were invited to meet the delegates of the International Map Conference; and on Sunday afternoon, July 17, there was a reception at the Science Museum, South Kensington, at which the Geographical, Meteorological, Geodetic, and Astronomical Collections were open to inspection by permission of the Board of Education. Both receptions were favoured with exceptionally brilliant and hot weather. The Society's House was open on Sunday for the convenience of members of the Congress.

On Monday morning, July 16, Mr. F. P. Sprent kindly described a special exhibition of manuscript and early engraved maps in the King's Library of the British Museum. In the evening there was a reception and conversazione at the Guildhall by the Lord Mayor and Corporation of the City of London, honoured by the presence of H.R.H. the Prince of Wales. The Guildhall Museum with its wonderful collection of Roman and other objects and the

Library with its historical documents and valuable books were on view, while for the lighter entertainment of the guests there were music and dancing.

This concluded the London programme, and on Tuesday, July 17, the Congress migrated to Cambridge. Meanwhile the calamitous news had been received that the Secretary of the Executive Committee, Mr. F. Debenham, of Caius College, had been taken ill on the eve of the Congress; universal sympathy was felt for him in that, having done the spade-work, the planting, and the watering, he could not witness the opening of the bud. However, he had recovered sufficiently by Monday, July 23, to be able to inspect the full-blown flower. In his absence Mr. J. M. Wordie, of St. John's College, had undertaken his secretarial duties; he was assisted by a local committee of ladies and gentlemen under the chairmanship of Sir Gerald Lenox-Conyngham. Local arrangements for ladies were in the hands of a committee presided over by Lady Darwin.

The headquarters of the Congress were at the Arts School in Bene't Street. The smaller Examination Room was fitted up as a Reception Room, with an Information Bureau opening from it, where members could obtain the badge —an appropriate ornament, with the World drawn upon the Transverse Mollweide Projection, described by Sir Charles Close in a sectional paper on July 20 —excursion tickets, postal facilities, and the usual pile of literature presented on such occasions. This bulky mass included "Great Britain," Essays in Regional Geography by twenty-six authors, edited by Mr. A. G. Ogilvie, which alone was worth the membership fee of £1, three I.G.U. Reports on Rural Settlement, Pliocene and Pleistocene Terraces, and Regions of Inland Drainage (the three not quite uniform in appearance), a useful and ornamental map of Cambridge on the scale of 12 inches to a mile specially prepared by H.M. Ordnance Survey, a catalogue of old maps exhibited by Sir George Fordham, a pamphlet by Sir Charles Close on the History of Geographical Congresses, and, of course, a handbook, list of members, and guide-book to excursions of the present Congress. General Meetings of Congress were held in the large Examination Room, where were exhibited on screens sheets of the International Map and specimens of work by the Geographical Section of the General Staff, while at the back of the room there was an exhibition of modern geographical books. Maps and books presented to the Congress were laid out on tables in the Reception Room. The University Library arranged an exhibition of old atlases in the cases in Cockerell's Building. Sir George Fordham's exhibition of old maps at the Department of Geography comprised eighty specimens, arranged to illustrate British Cartography from the sixteenth to the nineteenth century, and included Saxton's map of England and Wales originally made about 1584 and maps derived from it, such as *The Quarter Master's Map* prepared by Hollar in 1644 for use in the civil war; there were also fine examples of work by Cary and his successors, especially a map of Russia of 1814 and a map of India of 1824.

Tuesday, July 17, was chiefly occupied by members in settling into their temporary quarters. Some stayed with friends or put up at hotels; others were accommodated in colleges, particularly at Caius, Christ's, Pembroke, St. Catharine's, St. John's, Sidney, and Trinity, and these will have pleasant memories of their college life. In the afternoon, under the presidency of

General Vacchelli, there was an Ordinary Meeting of the International Geographical Union at which only representatives of the nineteen adhering countries were entitled to be present. The agenda included the nomination of the Finance Committee (Gen. Bourgeois, Gen. Gomez Nuñez, and Col. Sir Henry Lyons); a decision that the unit of contribution should in future be five pounds sterling (one pound sterling being considered equivalent to 25 gold francs), the presentation of the Reports of the Commissions on the International Map, Rural Settlement, and Pliocene and Pleistocene Terraces (the two latter Commissions being re-appointed), proposals for a uniform character and the better exchange of publications (the President's suggestion that three copies for each national committee should be supplied to the Central Bureau being accepted), and a modification in Regulation II for Congresses to the effect that the President and not the Executive Committee of the I.G.U. should be consulted by the Local Organizing Committee in sending invitations to individual geographers of countries not adhering to the Union. This meeting was immediately followed by a General Assembly of the Congress, at which Gen. Gomez Nuñez and Prof. Yamasaki were nominated Vice-Presidents of the Congress, and Presidents, Vice-Presidents and Secretaries of Sections were appointed.

The full list of the Sections and Presidents was: Mathematical, Cav. F. de Filippi; Physical, Prof. E. de Martonne; Biological, Prof. Ch. Bierman; Human, Sir Halford Mackinder; Historical, Dr. Isaiah Bowman; and Regional, Prof. E. Romer.

The Congress was not formally opened until noon on Wednesday, July 18, in the Senate House, when the Vice-Chancellor, the Rev. C. A. Weekes, Master of Sidney Sussex College, in welcoming members to Cambridge, said that just as seven hundred years ago a party of Franciscan friars under the leadership of an Italian came to Cambridge to study under the shelter of the University, so now the geographers of the world had come there to carry on their discussions in a congenial atmosphere *inter silvas Academi*. He remarked that the study of Geography had made rapid progress in this country in the twentieth century; in Cambridge a Readership in Geography was founded some ten years ago, and a Readership in Geodesy in 1922. But, though the Department of Geography now had a building of its own, it was the Cinderella of the University and still awaited a princely benefactor to raise it from its state of poverty. What struck the Vice-Chancellor most about modern geographical study was the number of sciences it laid under contribution, so that he was left wondering if indeed "there are more things in heaven and earth than are dreamt of in your philosophy." With that he declared the Congress open and wished it success.

The President, Gen. Nicola Vacchelli, then delivered his opening address in Italian; an English translation was in the hands of his hearers. After sketching the history of English exploration and the activities of the Royal Geographical Society, the address emphasized the conception of "geography as a study of the rational subordination of space to man" and maintained that, though the period of discoveries is far from finished, man needs an intensive knowledge of the territories of the known world. The President touched upon some of the problems to be brought before the Congress, and in a happy

phrase hoped that these few days of cheerful strain (*lieta fatica*) would contribute to the progress of our science. The audience rose at his concluding words of homage to H.M. the King and of gratitude and good wishes to the British Nation.

Members were soon called upon to maintain cheerfulness under strain, as they stood in blinding sunshine in front of the Senate House to pose for a photograph. The next event of the afternoon was a general meeting to receive the report of the Commission of the Carte du Monde, read by Major D. A. Hutchison in English and by M. de Margerie in French. There followed in the Arts School theatre an admirably lucid and concise lecture by Mr. O. G. S. Crawford on Archæological Maps, illustrated by lantern slides from air photographs. Later on, members were conducted round the Sedgwick Museum of Geology by Prof. J. E. Marr, and among the exhibits saw an interesting model of the Cambridge district, showing the terraces to be visited at the Travellers' Rest Gravel Pit two days later and also a morphological show-case in which hand specimens appear side by side with photographs of the corresponding land-forms. The social events of the day were a tea-party given by the Principal of Newnham, where Miss Caton Thompson lectured on Recent Excavations in Egypt, and an evening reception at Emmanuel College, where in the illuminated courts and gardens the Master, Dr. Peter Giles, received the guests, whose diversity of academical robes added to the picturesqueness of the scene.

The mornings of Thursday, Friday, Saturday, Monday, and Tuesday were devoted to meetings of the six Sections, though Section C finished its programme in a couple of days. The excursions which were organized for the afternoons are noted later.

In Cambridge the afternoon of Thursday, July 19, was occupied by meetings of the two Commissions and by a visit to the Museum of Archæology and Ethnology by invitation of the Curator. In the evening in the Arts School theatre the Dean of Norwich, Dr. Cranage, gave a charming and humorous lecture on Cambridge, the Town and University.

On Friday, July 20, there was a general meeting to discuss the Report of the Commission on Rural Settlement, at which a number of members, following the Secretary, Prof. H. J. Fleure, made interesting speeches. But in the somewhat oppressive atmosphere of the afternoon the Congress was glad to adjourn to a reception by the Vice-Chancellor under the trees of Sidney Sussex gardens.

At a Congregation of the Senate on Saturday afternoon, July 21, the Vice-Chancellor conferred the degree of Doctor of Science on Gen. Nicola Vacchelli, Prof. Emmanuel de Martonne, and Col. Sir Charles Close. The recipients were presented with appropriate Latin orations by Mr. J. C. Lawson of Pembroke College, acting for the Public Orator.

During the evening a limited number of members of the Congress attended a reception given by the Committee of Management of the Scott Polar Research Institute. They were received by Dr. H. R. Mill, Acting Chairman of the Committee, and, after viewing the exhibits of polar pictures, books, and examples of sledging material, they repaired to the garden, where Dr. Mill gave a short address dealing with the aims of the Institute.

Saturday afternoon and the whole of Sunday naturally gave opportunities for excursions and other gatherings, as well as for more informal "prowling about the city," to quote the apt phrase used by Sir Charles Close in his account of "International Geographical Congresses" (p. 15), where he tolerantly deplores the effect upon Congress business of the lure of Rome. The brilliant weather added much to the pleasure of the week in Cambridge as well as doing something to remove the traditional reproach at the climate of England, though it lent point to the remark—by a Frenchman—that English weather is too fickle for one even to depend upon its changing.

Monday saw a return to the more serious side of Congress activities in all sections, except that of Biological Geography, which had, as noted above, ceased to function. The afternoon of this day stands out as not entirely remarkable for that "unanimité" which the President did so much himself to promote. The exception occurred in connection with the General Meeting of Congress to discuss the "Report of the Commission on Pliocene and Pleistocene Terraces." A brisk debate on the report itself took up most of the time available. The discussion which followed—as to representation on the Commission—thus had to be interrupted by an announcement that the Duke of Apulia was beginning his lecture—"The Tripolitanian Sahara." The meeting was thereupon thrown into some confusion. Happily Mr. Bullough, of Caius, who on this as on other occasions brought to his task of interpreting a helpful breadth of treatment, was able to ease the language difficulties. In the sequel, at the final meeting of the General Assembly on the following Wednesday, the Executive Committee, offering its congratulations to the Terraces Commission, left the details to be settled by the Commission itself.

It was a pity that so many were deprived of the pleasure of listening to the Duke of Apulia's exceptionally interesting lecture. It is hoped, however, to print this with some fullness in the Congress Report. A tea-party at Girton and another lecture in the evening also fall to be recorded for this day. Sir Francis Younghusband described the Shaksgam valley, a region of special interest to those who were familiar with Major Kenneth Mason's stereographic survey, and the reduction of that work with the Wild Stereo-plotter (*G.J.*, October 1927).

In the afternoon of Tuesday, July 24, in the Arts School Theatre, there were three lectures of a general character and all of a high order. M. C. de la Roncière dealt with some lost manuscripts of early French travellers, Prof. Douglas Johnson with "Sea-level changes in North America," and Prof. de Martonne with the work he had done, in collaboration with M. Aufrère, on "L'Extension des Régions privées d'Ecoulement vers l'Océan," already published as a handbook for the present Congress in pursuance of a resolution passed at Cairo.

This was followed by an exhibition, in the Main Hall, of a series of large-scale maps arranged by Mr. A. G. Ogilvie to illustrate the fluvio-glacial beaches, the raised terraces, etc., of the Moray Firth coast, together with a set of aeroplane photographs of Blakeney Point and Desert Sand Dunes in Sinai and Palestine arranged by Dr. Hamshaw Thomas.

The dinner given by H.M. Government at Trinity that evening naturally stands out as the most brilliant of the social gatherings. The necessary limita-

tion of the number of guests to 150 must have given an unenviably difficult task to the selectors, and the result, as was to be expected, gave rise to some heart-burnings, though the general reception afterwards in St. John's College was very well attended and no doubt went far to alleviate any feelings stirred by the distinction.

The actual ceremony of reception in the finely panelled Gallery of St. John's, dimly lit by candlelight, was a picturesque event, and the music at both functions was a joy to hear, especially Stanford's Elizabethan Pastoral, sung towards the end of the Trinity Dinner.

Sir Austen Chamberlain, at the Dinner, proposing the toast of "The Sovereigns of the Kingdoms and Presidents of the Republics represented," said that it was nearly sixty years since the first Congress of that kind was held, an item of information together with others of a like nature that he ascribed with humorous modesty to the work of his library staff at the Foreign Office. But he was clearly uttering no second-hand opinion ready served to him when he characteristically went on with great frankness to deplore the absence of official representatives from Germany. He could not help, he said, contrasting this abstention, for it was clearly that, on the evidence presented to him, with the larger issues summed up for the world in the word "Locarno." "Similar circumstances might have been pleaded by German statesmen as a reason for refraining from joining the even more important society, the Society of Nations. They took a larger and wiser view both of their duty to the world and their own interests. They were welcomed to that great society as colleagues and friends. They contributed fully to the discussions, and he hoped that before long, before the next Congress meeting, the German scientists would do what the German Government had done, and accept the welcome that was waiting for them."

To these words may be added the hope that Austria, Hungary, and the Baltic States, though the circumstances of abstention in these cases may not fall into quite the same category, will all equally accept the welcome that is waiting for them and re-establish the continuity that is at present somewhat lacking between the two post-war Congresses and the ten preceding. In this connection two points seem to call for mention: the account of the history of the International Geographical Congresses, written by Sir Charles Close and giving in a succinct form a valuable collection of material from original sources, not always easily available; and, in the second place, the question whether, in spite of the change of status, it would be convenient, as some think, to continue the numbering from the pre-war series. This will perhaps become more feasible with the realization of the hope expressed that Germany and other countries may before the next Congress give their adherence to the Union. Mr. Ogilvie's designation (on the title-page of 'Great Britain') of the London–Cambridge Congress as the Twelfth was a mistake which may prove to be no more than intelligent anticipation.

The arrangements for the closing day, Wednesday, July 25, corresponded roughly to those of the opening afternoon—a Meeting of the General Assembly of the Union which, its business done, dissolved to make way for a General Meeting of the Congress.

The report of the Finance Committee signed by General Bourgeois showed

that the sum to the credit of the Union was £886 7*s.* 10*d.*, and that the income for the year 1928 will be between £322 and £400, according as the nineteen states adhering to the Union, and putting up eighty units of contribution, have arranged to pay on the old scale of 500 French francs, or the new, 125 gold francs=£5 sterling. The sum of £400 is to be transferred from the funds of the Union to those of the Congress to assist in the publication of the Report. Generally, the Finance Committee was satisfied that the position indicated covers anticipated expenditure, including the cost of publication of the reports of the various Commissions, no change being necessary in regard to the units of contribution made by the adhering states.

Other matters discussed were the continuation of the Terraces Commission and the development of representation already mentioned, together with the continuation of the "Habitat rural" Commission and the acceptance of sectional recommendations to form new Commissions to deal with the following matters:

(1) Variations of Climate in historic times, as proposed by Prof. de Marchi and Prof. de Martonne.

(2) Palæographical Maps for the plio-pleistocene epochs, as proposed by Prof. Biasutti. This Commission is recommended to get into touch with representatives of geology.

Acceptance or agreement was also accorded by the Union to proposals or resolutions dealing with the following:

(i) Study of Fauna and Flora of Mountain Regions, as proposed by Prof. Biermann and Prof. Rudmose Brown.

(ii) Map of the Roman Empire on the scale of 1/M as described by Mr. O. G. S. Crawford and formally proposed by Brigadier E. M. Jack.

(iii) Inventories of ancient maps to be made in the countries of Europe, following the model of *Monumenta Cartographica Italiana*, as proposed by Prof. Almagià.

(iv) Co-operation with the International Assistance Union, an offshoot of the League of Nations. The activities of this body touch the science of Geography in the matter of the proposed systematic collation of such data as have already appeared in various publications, particularly in "Matériaux pour l'Etude des Calamités," and in the preparation therefrom of an "Atlas of Calamities," which is the gist of the invitation put forward by Count Elia.

The announcement was made that the next Congress was to be held at Paris in about three years' time. At this point Prof. Romer rose and was accorded leave by the President to make a statement in which he expressed the keenest disappointment that the next Congress was not to be held at Warsaw, in response to the desire already twice expressed, at the first General Assembly of the Union at Brussels in April 1924 and again at the close of the Cairo Congress of 1925. Feelings of friendship and of sympathy with France prevented him from disputing the decision of the Union just announced, but he very earnestly hoped that consideration would be given to the invitation once again put forward on behalf of the geographers of Poland and in the name of its Government, who were anxious to accord to the Congress their generous hospitality.

General Vacchelli, in reply, assured Prof. Romer of the Union's gratitude

and consideration for his proposal, observing however that the present Executive could take no decision which would tie the hands of that to which it now had to give place.

It will be appropriate at this point to record the list of officials for the period now beginning:

Président: Général R. Bourgeois; 1er Vice-Président: Général N. Vacchelli; Vice-Présidents: Prof. N. Yamasaki, Général G. Severo Gomez Nuñez; Sir Ahmed Hassanein Bey, Dr. Isaiah Bowman, Sir Charles Close; Secrétaire Général: Dr. Filippo de Filippi.

The list was read and accepted by the Assembly without dissent, and the Assembly was then dissolved to be succeeded after a short interval by the Final Meeting of the Congress. The Vice-Chancellor and authorities of the University were cordially thanked for their hospitality, and a vote of thanks was also passed to the retiring President.

In his closing address General Vacchelli said that he was glad to conclude the labours of the Congress by stating that it had achieved a memorable stage in the progress of geography in its various aspects, mentioning especially the resolutions dealing with climatic variations within historical times, the formation of a programme dealing with the fauna and flora of high mountain regions, and collection in a complete catalogue of the various cartographical codices scattered in the libraries of Europe. He referred also in terms of high commendation to the "Regional Studies of Great Britain," and the rapid advance which is being made in the "Carte du Monde au Millionième." He was glad especially to welcome the representation of the United States of America among the adhering nations, the number of which had risen from fourteen to nineteen during his term of office, and repeated Sir Austen Chamberlain's hope that other countries, with valuable contributions to bring to geographical science, might see their way to join the Union. He concluded what all will feel were for him especially days of "lieta fatica" by a happily phrased expression of gratitude to the various persons and bodies which had done so much to make the Congress a success, with sincere wishes for the prosperity of Great Britain and His Majesty King George V.

During the Congress excursions by motor coach were organized chiefly to three regions, Ely and the Fenland, the chalk area south of Cambridge, and Breckland. Prof. J. Stanley Gardiner led a party to Ely and Wicken Fen on Thursday, Prof. V. R. Creed took another party to Ely on Saturday, and on Sunday Mr. F. L. Engledow showed the agriculturalists the "black land" of the fens. The chalk area was visited on Thursday under the leadership of Mr. W. B. R. King, and the villages of South-East Cambridgeshire on Monday under that of Dr. Palmer and Mr. J. Jones, while in the opposite direction Mr. T. C. Nicholas led an excursion to the Jurassic Rocks of Northamptonshire on Sunday. The visit of Saturday to the meres of Breckland was chiefly of botanical interest; the archæological features of this district, including the flint-mines known as Grimes Graves, were the object of an excursion on Sunday organized by Mr. J. M. Wordie and Mr. T. C. Lethbridge. There were also visits to two historic houses, Sir G. Lenox-Conyngham taking a party on Saturday to Hinchingbrooke by Huntingdon, and Lady Darwin taking another on Monday to Audley End.

The most popular excursion was that to Blakeney Point organized by Dr. H. Hanshaw Thomas, which occupied the whole of Sunday. Members were received at the Point by Lord Ullswater, Vice-President of the National Trust for the Preservation of Places of Historic Interest and Natural Beauty, the local committee of which had invited this visit from the Congress. Prof. F. W. Oliver explained the coastal formation, Dr. E. J. Salisbury the vegetation, and Dr. S. H. Long the birds of this remarkable spit, while Dr. T. G. Hill gave a general description.

After the Congress there was a choice of three longer excursions, two from Thursday to Saturday, and one lasting a week. Prof. O. H. T. Rishbeth led a party to Oxford, Newbury, Salisbury, Southampton, and London. At Oxford the party, under the guidance of Prof. J. L. Myres, visited the Colleges, learning, *pace* the Congress handbook, that Cambridge was not unique in the number of its Colleges. They were also entertained at the School of Geography by Mr. H. O. Beckit. The first night was spent at Newbury, where the Mayor and Mr. Harold Peake explained the interesting features of the Museum. On the way to Salisbury, Beacon Hill near Highclere Castle was climbed and afforded a very fine view. The route from Salisbury to Southampton was down the Avon valley and through the northern part of the New Forest. On the following morning Brigadier E. M. Jack welcomed the party at the Ordnance Survey Office, where the various technical processes were explained by the staff. The final stage of the journey to London was by Portsdown, Butser gap, Hindhead, and the Hog's Back.

The excursion led by Prof. Rodwell Jones and Dr. L. W. Wooldridge covered roughly the area of the London and Hampshire Basins, viewed from well-chosen strategic points—in the structural sense—such as Beacon Hill (near Ivinghoe), Marlborough and Hindhead. At the first-named the leaders of the excursion gave illuminating accounts of the Chiltern Hills, the plains they overlook, and the gaps by which they are traversed. At Marlborough Mr. C. C. Carter supplied an exceptionally able account of the beautiful and structurally remarkable country which forms the divide between the London Basin, represented by the Kennet prolongation, and the Hampshire Basin, into which the Vale of Pewsey leads by way of the upper Avon. The excursion was fortunate in having Mr. O. G. S. Crawford at Stonehenge, though he was unable to provide for so many to study archæology from the air! The return journey was made by way of Romsey, Winchester, and Hindhead, where, under the guidance of Dr. Wooldridge, the Western Weald was surveyed, and then by way of Guildford Gap and the commons of Ockham and Esher to London. This excursion was well organized and those taking part gained a good insight into a characteristic English area.

The third excursion, led by Prof. H. J. Fleure, visited Wales and the Welsh Marches. The physical problems studied included the Snowdon range and its dissection, the drainage history of West Wales, the Old Red sandstone escarpment and coal valleys of South Wales, and the incised meanders of the Wye. In each instance, the relationship with man's activities was emphasized so that a comprehensive view of Welsh life was obtained. Members also had the opportunity of visiting Stratford, Shrewsbury, Carnarvon, St. David's, and Oxford.

J. H. R.
A. J. P.

THE CORAL REEF PROBLEM

THE CORAL REEF PROBLEM. By W. M. Davis. Special Publicatn. No. 9. *American Geographical Society. New York* 1928. 10×7 *inches;* 596 *pages; maps and illustrations.* $6

PROFESSOR MORRIS DAVIS commenced his investigations of coral reefs in 1913 at an age when most men are thinking of retiring, and has devoted all his available time and energy to them ever since. He spent the year 1914 wandering over the Pacific, visiting thirty-five reef-encircled islets and a long stretch of the Queensland coast behind the Great Barrier Reef; he subsequently examined New Caledonia, the Lesser Antilles and other areas. His researches are embodied in over thirty papers, but these may be regarded as summarized in and largely superseded by this present volume. It contains his study of lands enclosed in fringing and in barrier reefs from the geographical viewpoint and is doubly valuable as being the work of a competent geologist, able to appreciate fully the nature of their rocks. Here he is on firm ground of his own choice, and he has succeeded in establishing for very many lands the probability that their surrounding barrier reefs commenced as fringing flats on the shores of often relatively high islands, which, either by the subsidence of the Earth's crust beneath them, or by some positive change in the level of the ocean, became partially submerged. The reefs themselves continued to grow vertically upwards, the land behind becoming progressigely separated, leaving a lagoon. This is Darwin's theory, which goes on further to imagine the complete disappearance of the central land, leaving an irregular rim of reef surrounding a lagoon, viz. an atoll. This theory, in its universal applicability to coral reefs, was contested vigorously by nearly all field explorers of twenty to fifty years ago. In those days there was no conception of important positive and negative movements of the ocean level, now embodied in the Glacial-Control Theory, and the geologist wrote of the Earth's crust under the oceans as if it were a plate that must sink or rise all together. To-day we are free to consider for each locality the weight effects of each islet or other mass, even those of the coral reefs built up by organic agencies. The advance of the science of isostasy allows such new conceptions and freedom that the critic of to-day has no right to be severe on the views of his predecessors, provided they have honestly given the facts on which they build. To do him full justice, Davis states fairly what he finds, gives his conclusions honestly, does not profess to be what he is not, viz. a biologist, and following Darwin and Dana has produced the third standard volume on coral reefs. He deals first-hand with the facts inferred from the past histories of the lands of the regions he visited, but the rest of his statements as to the conditions in respect to existing fringing, atoll and barrier reefs depend on the materials collected by a very miscellaneous body of observers, few of whom have wide and long-enough personal experience of coasts, of reefs and of marine conditions to allow them to make assuredly accurate statements.

The subsidence theory, especially if supplemented by glacial changes in ocean level, brings into relationship the topographical facts connected with different kinds of coral reefs in an easily understandable manner, but Davis sets out to give independent verification. Dana first gave this in the existence of "deep bay-indentations in coasts as the termination of valleys." These embayed valleys, as they are termed, must display, in the topography of their lateral slopes, evidence that they were once cut out of the land by subaerial degradation, if they are to be regarded as evidence of subsidence; these slopes should bear a distinct relationship to and merge into those of the land valleys above. The embayed valleys would doubtless have floors built up by deltaic and other

sediments, and there may be coral formations around their shores, but, for any land with a number of such embayments, these angles of slope should give some measure of the extent of its change of level. If of firm volcanic or granitic rock, the sea would in any pause in subsidence form cliffs round outstanding points and to a lesser degree in the embayments, but, if protective coral reefs existed, these would be non-existent and the land would be described as non-cliffed. An island, which had not subsided, would have no or very few bays, and its shores would be cut back into cliffs. Furthermore, some sort of a shelf would be cut around it, and this as it broadened would be covered to seawards by growing reef organisms, while later by the supposed subsidence its cliffed parts would disappear though the tops of some high cliffs might persist. As further evidence of subsidence, the limestone material of elevated coral islands should lie unconformably on the basal rock, and the latter should show surface characters and slopes explicable only upon subaerial degradation. Scarcely to be put in the same category is the disappearance of detritus from the coasts of maturely dissected islands, the products of their erosion, since there is good evidence to show that current and other submarine actions can do much. When our author writes of drowned atolls and of biological evidence I feel he is indulging in special and quite unnecessary pleading; there is no certain evidence of drowned atolls.

Alternative theories to that of subsidence are the subject of discussions into most of which we need not follow. Guppy's account of the Solomons and Semper's of the Pelews lead us nowhere. Solution is not the chief active process that could excavate lagoons, but yet the idea of lagoons being formed solely by this means persists. My own reading is that Murray and the thirteen authors cited with him regarded subsidence as unnecessary for the reefs they examined and as unlikely for very many reefs in view of the prevailing ideas of their times. A. Agassiz saw many more reefs than any man living, but he examined very few in detail, and we must largely agree with Davis in his criticisms of his "platforms of submarine erosion" and reefs forming but "a thin crust on the underlying base"; such statements deserve no more credence than if a geographer looked at an inlet and called it an "embayed valley" without giving any evidence of such. It may be that Wharton's views, like my own, are "against the concensus of geological opinion," but I have failed to find any evidence cited against Wharton's idea of an island being cut down by waves and currents to a flat bank 30–40 fathoms deep, while I must still maintain that my view of the Maldive foundations is possible. Lastly, the adequacy of the relatively deep-sea corals and other lime-secreting organisms to build up a reef from a few hundred fathoms to the surface is not contested.

Daly's glacial control theory deservedly receives fuller consideration. It supposes that the accumulation of ice in polar regions and the consequent lowering of water surface in the glacial period was accompanied by such a chilling of the ocean as to inhibit the growth of (or to kill) corals and other reef-building organisms over the greater part of the coral areas. Waves would cut away or remove many islands, while others would have wide benches carved around them. In post-glacial times the sea would gradually rise 30–50 fathoms, and on these platforms, assuming almost stationary conditions, atoll and barrier reefs would grow up, the temperature having now become suitable for reef-forming organisms. Darwin's theory has been regarded by some writers as proving subsidence and Daly's as proving the existence of abrasion platforms and a considerable positive post-glacial rise of the ocean, none of which are capable at present of direct proof. On the other hand, this theory cannot be disproved until elevated post-glacial coral reefs are discovered, the foundations of which can be studied. The factors required are all probable, though no reliance can be

placed on any special figures of water-movements. In any case it must be considered likely that ordinary alterations due to elevation and subsidence were continuing during the whole period of glaciation and post-glaciation. Some of the topography works out excellently with this theory, but lands would have been especially heavily cliffed in glacial times owing to the absence of protective organisms, and these cliffs might be expected to have been much more persistent behind the barrier reefs, which were built during the rise of the ocean consequent on the melting of the ice-caps.

Oceanic islands—the term "pelagic" is in general use for floating organisms and should be so employed according to the law of priority—are divided into those of the coral areas, the marginal belts of the same, and the cooler seas, and from their topography are deduced the oceanic effects of past ages. When the action of waves and currents have been more studied perhaps Davis' ideal profiles of stationary, subsiding, and rising islands will have to be modified. The supposed rarity of submerged banks in cooler seas may be quite well due to low temperature inhibiting organic growth as compared with higher temperatures in coral seas favouring the same. It is impossible, however, to follow Davis here without an intensive study of the charts, temperatures, salinities and water-movements round the islands and banks of the cooler seas and of the marginal belts. We feel that much of the topography of the latter is most happily explained on the glacial control theory, subsidences and elevations coming in occasionally (cf. Lesser Antilles), but we see no evidence to suggest that the banks around these islands represent coral reefs. Experiment may show that it is not temperature, but some other factor, which governs reef-coral distribution, for there are other corals which can live quite well at much lower temperatures and indeed almost completely cover and perhaps build up banks. The true reef-corals all feed largely by the algæ which live in them; this fact governs their distribution in depth, viz. the depth to which light of sufficient intensity for their green colouring matter to function can penetrate sea-water, and may also control their supposed temperature distribution as well.

Reefless coasts and thirty-six reefless young volcanic islands of coral seas are referred to, but we wonder whether Davis, if he had seen Réunion, would have prophesied about it with such certainty. I would point out that movement of sharp sand along coasts cuts into and destroys seemingly well-established corals. Tutuila, Tahiti and New Caledonia are regarded as next stages from Réunion, showing the upper parts of cliffs, formed before reefs protected their coasts, and also certain embayments. They are perhaps the three islands that might be chosen to illustrate glacial control; yet I am disappointed, for I can find no data upon which I can calculate alterations in level, nor in the original publications such photographs as are convincing as to their valley estuaries being really embayments, as they probably were. Four weeks were spent by Davis on six Society Islands, while Crossland has lived for over a year on Tahiti, the chief subject for discussion. If, as Crossland states, masses of volcanic rock are found in all its reefs, it is clear that the island has been almost stationary for such a long period of time that an origin for the bays, other than alteration of water-level, may have to be sought. Add to this the further statement of Crossland that its barrier reefs are washing away—they are not typical of coral reefs in general—and a good case is made out for a complete reconsideration of all deductions, not based on quoted facts and figures. I know from experience the difficulties in the field, but I cannot for a moment believe that embayments cannot be established by figures of heights and depths, angles of slopes, photographs from two fixed spots, etc.; in effect, I ask for impressions to be replaced by detailed field work.

The study of barrier reef-fronted lands is immeasurably the most important part of Davis' work, and a section from which all future research will evolve. Practically all the islands in question are volcanic and of quite recent formation. The contention is that, wherever these lands show deep bays, there has been the submergence of water-cut valleys, and that they could have been formed by faultings or by subsurface sea action is quite impossible. With the general improbability of these we cordially agree: such lands undoubtedly give the best proof of Darwin's theory. Adopting Davis' methods, we take present islands and barrier reefs and attempt to reconstruct the original lands. Thinking of land slopes into embayments, we deal with alterations of level of hundreds of feet and under barrier reefs of as many thousands. The former may be regarded as proven, and the depths of lagoons and embayments agrees with glacial control. The latter theory is a suggestion, not a determined phenomenon, but there are several groups, where the totality of embayments, the contours and absences of cliffs, the depths, etc., make subsidence probable, especially if allowance be made for the much longer continued abrasion of the emergent land as compared with that of the original land mass, much of which may well have been of ash or loose texture. Unrimmed parts of the lagoon floor are "supposed to have been kept free from reef growth by the outdrift of sediments," and the depth is "in adjustment to the waves and currents acting upon it." No evidence is given for these statements. These areas are not covered by detritus or sediments and are not usually free from organic growth, so far as I can judge by many dredgings. The point is immaterial, but there is no more justification for this statement in respect of Indo-Pacific reefs than there is for platforms of erosion (Agassiz), of low-level abrasion (Daly), or of any platforms anteceding the reefs (Vaughan).*

The author's study of elevated fringing reefs reveals in many cases a more or less embayed coast behind, this due to subsidence. The most extraordinary of all elevated barriers is that of New Georgia, at least 50 miles long and attaining a height of 260 feet. Unfortunately its geology and topography, especially lagoon depths, are little known, but the lagoon must have been at least 75 fathoms when elevated, unless subsequently deepened, while the supposed factors point to probable shallowing. Mangaia is better known, an island at least 350 feet high with a lagoon of 45 fathoms, all now elevated for 200 feet. The bottom of this lagoon was not laid bare by elevation, and there is hence no evidence that this barrier reef is founded on a fringing reef. This is certainly the most remarkable recent find in coral-reef regions, but, to take Davis' analogy of an inspector taking a sample tin, the label says, " Barrier Reef (no guarantee as to foundation, lagoon, composition or date of canning)," the last because the sole fossil found may still be living in the neighbouring unexplored seas. The information we have certainly points to subsidence, but Davis goes too far in suggesting that this theory thereby "deserves acceptance for all other barrier reefs also; and indeed for most atolls as well."

*I regret to discover that I once expressed views in respect to the Great Barrier Reef. I then imagined it to be a faulted area with parallel faults between the land and deep sea between which the reefs grow up, having in mind certain descriptions of the Florida reefs by Louis Agassiz. Davis himself writes to me to correct his statement as to the absence of strong cliffs (p. 359), Stanley having made "it clear that the Queensland islands have a fair number of plunging cliffs, rising 100–200 feet and descending to depths of 10 or 20 fathoms, on their exposed sides." I believe the next stage in the problem of coral reefs is to concentrate on a few areas, and I recommend the Great Barrier Reef and Tahiti as most likely to give definite results. The former is, I believe, an area of considerable instability that should be watched for both scientific and practical reasons. I draw attention to the splendid service of Professor Richards in organizing and governing the exploration of this area.

The very original discussion of the Fiji Group is perhaps the most illuminating section of the whole study. This great area has atolls, barrier and fringing reefs; some lands are due to quite recent volcanic action, others, much dissected, to ancient vulcanism and perhaps elevation; there are some elevated atoll-like reefs and other elevations are of mixed rock. There are certain lines running roughly north and south, each with the same class of reef and island. The suggested origin is a slow-moving earth wave, the crest islands mostly elevated atolls, the trough banks atolls formed by subsidence. Reef-encircled limestone islands are being rapidly washed away, and we feel that due regard is not paid to this action resulting occasionally in the formation of atolls and barrier reefs. Here and elsewhere, examples of supposed tilted atolls are given. The view of Suess that the level of the ocean has been lowered by an universal sinking of the same by about 330 feet is entirely negatived as a recent phenomenon, for each elevated reef has a height of its own, even to 4300 feet on Timor. Roti, near Timor, Barbados and Christmas (Indian Ocean) are considered to be the only islands that at all support Murray's views. Other Indian Ocean islands have only trivial elevations that might be explained by recent ice accumulation in polar regions. Goram has a series of shelves, one above the other, each sloping inland to a cliff; Wallace interpreted these as fringing reefs with very shallow lagoons, and, if this is correct, they might be claimed as evidence of Murray's theory.

Submerged reefs and banks prove to be relatively numerous in coral seas, and some groups, such as nineteen banks north of Fiji, are remarkably uniform. The vast majority do not exceed 40 fathoms, and this suggests glacial control, though here they are regarded as submerged atolls. While there are a fair number with depths to 100 fathoms, Davis suggests that "the rarity of still deeper banks may be due, in part, to their aggradation by organic detritus," but his theory impels him to add "after the cessation of an active subsidence by which a greater depth would otherwise have been caused." Are there in this coral region no irregularities of the ocean floor caused by folding, tilting, etc., or even by submarine eruptions? Allowing aggradation, such would certainly grow up to surface reefs. Many banks, which border islands, to one "speculative theorist" are underlain by "barrier reef lagoon floors." Another would explain them, in part, by abrasion, but these banks do not seem suitably shaped according to the theoretical deposition of detritus by such currents as we can postulate around them. The Western Indian Ocean does not interest Davis as much as the Pacific, and rightly so, for it gives little evidence of anything. It has a series of immense submarine banks with or without shallower rims and surface reefs. The fact that volcanic ash was dredged off Providence reef at 744 fathoms, much of it manganese-covered, is not mentioned; this points to water-movements at this depth preventing aggradation around shallower areas and gives the only clear evidence of the foundation of any isolated reef. The slope of the land under the bays in the islands of the Seychelles are not, I think, valley slopes, the land being granitic, about 157 sq. miles on a bank of over 20,000. It seems to me not only "possible" but probable that these great banks were in origin "independent of coral reefs," which later commenced to form upon them. Surely this region differs from all Pacific coral-reef areas in being perhaps part of the site of a comparatively recently existing continent, the destruction of which is a mystery. In any case it is difficult to make certain by dredging whether the rim of a bank is growing up or being removed; thus there is always the unlikely alternative that a bank is a coral reef, which is being washed away. I personally entirely discredit mud-control in the governance of Great Chagos, as suggested by Daly; by the way, Peros Banhos, Solomon, Egmont, as well as Diego Garcia, are atolls, not drowned atolls.

The whole study leads up to the atolls, any one of which studied by itself can be explained by any one of the various theories. Each has to be considered as to whether it belongs to an area known to be unstable, or whether it lies near barrier reefs, or whether it has, like Funafuti, no neighbours. All are very alike in external slope, gradual to about 40 fathoms, steep to about 140 fathoms, and then more and more gradual to the general level, perhaps 2000 fathoms below. On the subsidence theory this topography must be explained as due to the movements of the oceanic waters, for otherwise the steep would be expected to continue for the 1000 fathoms or more of the subsidence. Of this water-control there is some evidence, for there are found somewhat similar slopes off islands and a certain merging into those of continents. On Wharton's view, that lands could be cut down by surface wave action and by wind and tidal currents to form flat banks on which atolls would directly grow up, the actual topography agrees with the theoretical. The depth of the banks would depend on their size, and the larger, giving more resistance to the currents, would be deeper. Even the hardest rock will yield to perpetual wear—imagine the cutting up of land by aerial agencies and the totality of wear is much greater here—and volcanic islands, as Falcon in Tonga, formed by submarine eruptions, are of ash, any harder core being of later formation, when the vent is protected from water. Deep banks growing by aggradation would, I am disposed to think, generally form flat banks in open seas at about 40 fathoms due to a quite long period before the reef organisms could get root—they are not organisms with larvæ and hence do not belong to the more readily distributable groups. All these views imply a shaping by water-movements of the basal banks, and here they are weak so far as general applicability is concerned. Making the most excessive allowance for eddies, etc., can we conceive water-movements to give the bizarre shapes of so many atolls, shapes quite explicable on subsidence? Regarded thus, perhaps the most regular forms are in the Maldive area, and I am still inclined to think that my original conception, brought up to date by more recently acquired knowledge of currents, etc., is as likely to be correct as Davis' new interpretation of the features as slowly subsiding fault blocks of the old Indian Ocean Gondwanaland, which incidentally is no longer to be regarded as a biological necessity.

It must be clear how greatly impressed I am with Davis' book and views. I started to get such information together before the war and was adding cards up to a few years ago, when I discovered that the cost of publication would be prohibitive. I am quite satisfied that the future researcher should use Davis' work as a foundation for the Pacific, where the main interest of the problem lies. I still think there are three or four other methods by which foundations have been produced, but they are all secondary to the subsidence view. The glacial-control theory intrigues me, for there must have been similar changes in several geological periods and some of these have outbursts of evolution, suggesting such changes as their impelling cause. For future progress we must pay more attention to land inlets, while the unconformability of many elevated reefs rests on the opinions of untrained observers. Much of the objection to Darwin's views seems to me to have been inevitable, for when I visited Fiji physicists allowed me little latitude, agreeing with Darwin in talking of "the grand and harmonious picture of the movements which the crust of the Earth has undergone within a late period. We there see vast areas rising. . . . We see other wide spaces sinking . . . and we may feel sure that the movement has been so slow as to have allowed the corals to grow up to the surface" (ed. 1889, p. 195). To-day our motto is "each reef its own story." Under stress an earth wave may form from a centre and become petrified in crests and troughs. There may be breaks,

vents through which the fluid lavas will exude. Any alteration of weights in a stable region will produce instability, and forces are at work to get back to stable levels. But they are not allowed to do so by themselves, for organisms collect on any elevations, and, if these reach within the level of reef-builders, their rate of accumulation is enormous; their material is at least twice as heavy as sea-water. On the basis of the known reefs of Funafuti it would there mean the weight of a basin of additional water of over 150 sq. miles by over 1200 feet deep. It is surely not too much to imagine that this and many other reefs owe the apparently great depth of their foundations to the success of their reef builders in producing further instabilities and stronger forces or weightings which must inevitably be met by subsidences, that, as the addition of weight is continuous, would themselves be continuous.*

One word of warning and a plea for the study of lagoons and their passages, the depths, the deposits and the water-movements. Lagoons seldom attain to depths greater than 60 fathoms, whereas subsidence, however produced, may seem to demand hundreds. The topography of the outer slope and the depths of lagoons may be correlated with wind, wave and current movements, together with deeper situated return currents, always remembering that tidal movements will be translated into currents over banks. Davis does not examine the question of the filling up of lagoons, but trusts to Providence and assumes aggradation in dozens of places. In one of the areas he has seen he refers to the lagoon cliff, which is a very general feature within landless reefs, and which is difficult of explanation if detritus from the reef is supposed to be swept inwards to fill up the lagoon floor, the greater part of which is bare, free from all sedentary life. I thought it worth while to describe Addu lagoon from this standpoint, for it seemed to be filling in, this in sharp contrast to the rest of the Maldive lagoons, particularly that of Suvadiva with its floor covered by casts of foraminifera, apparently an analogous formation to glauconite. There are vast areas outside reefs covered by coral mud; how is this formed ? It cannot come from the erosion of the outer slopes of most coral reefs, for these are largely covered by living organisms, a layer of organic matter which quickly heals wounds and prevents damage. Is this mud from lagoons? There are known a range of organisms which can break up the hardest corals into mud that will pass into suspension in the water. Has mud and other material anything to do with keeping open the passages into lagoons, inhibiting the growth of certain essential corals? Is there any correlation between the depths of these passages and that of lagoons? But why go on? One and all men who have thought and worked at these coral-reef questions ask for the fullest investigation of these and all matters relating to reefs, feeling that nothing as yet is assuredly determined; the field is vast, its parts exceeding diverse.

J. STANLEY GARDINER.

*On glacial control there would also be vast alterations of forces, such alone as might appreciably change the shape of the world and affect the vast areas of Darwin. This is too theoretical at present for further reference.

CLAUDIUS RICH: SCHOLAR AND PIONEER

BAGHDAD IN BYGONE DAYS. By C. M. ALEXANDER. *London: John Murray* 1928. 9×6 *inches;* xvi+326 *pages; illustrations and maps.* 16*s*

THE title of this book barely suggests its scope and importance as the record of an extraordinary career, based on hitherto unpublished letters and journals. The portrait of Claudius Rich has a look of one of those gallant Elizabethans who were adventurers by temperament, and accomplished courtiers by necessity. Both the portrait and the story of his life reveal also an intellectual and artistic nature, gentle, high-minded, and sensitive. In scholarship, and in affairs, he reached a level of achievement which makes it strange that only the devoted research of his great-great-niece has collected the material for this biography, more than a hundred years after his early death. If Rich's abilities had been given to soldiering, as he once intended, or concentrated on any one of the branches of knowledge which he studied so eagerly, his fame would have been greater—though not the actual value of his services to his country.

The scanty details of Rich's boyhood seem to prove that he was predestined for the East. As a boy, living in a suburb of Bristol, he learned Oriental languages for his own delight, and at the age of seventeen (1803) he was granted a military cadetship under the East India Company. But at Leadenhall Street he was introduced to the Company's librarian, Charles Wilkins, the great Sanskrit scholar, who discovered a "literary wonder" in this youth, and persuaded the Directors to exchange his appointment for a writership on the Bombay Establishment. Pending a vacancy there, Rich was given the post of secretary to Mr. Charles Lock, who had just been made Consul-General for the Mediterranean, with headquarters at Cairo, acting also as Agent-General for the Company in Egypt. Rich accordingly cancelled his passage to India and sailed to join his chief at Malta on 8 February 1804 in the *Hindostan*, laden with stores for Gibraltar and for Nelson's fleet. Off the coast of Northern Spain the ship caught fire, and the crew were compelled to run her ashore in the Bay of Rosas. The sailors were taken off by a frigate, but Rich, as a civilian, was left stranded till a Bristol merchant trading in Barcelona heard of his misfortune, and hastened to befriend him.

When Rich again set out, it was by slow coasting vessels to Italy, where he spent three months, "chiefly at Naples, where he began to study what became one of the passions of his life—music"; and became proficient in the language. Soon after he reached Malta Mr. Lock died of fever, contracted on his way back from Constantinople.

This involved another change of plans, and Rich took advantage of the Directors' suggestion that he should go to Constantinople to perfect himself in Turkish and Arabic. After a few weeks in the capital he went to Smyrna, where he attended lectures at the college and mixed freely with his fellow-students. In 1805 he was apparently employed as one of the Company's secret agents in the Asiatic province, visiting Aleppo and Antioch, and going as far north as Boli, Amasia, and Tokat.

In the following year he was appointed assistant to Mr. Lock's successor at Cairo. While there he worked hard at Arabic, but joined also in the social life of the city, making friends with some of the Mamelukes who were then powerful in Cairo, and learning from them their tricks of horsemanship, the use of scimitar and lance, and how to wear their distinctive dress. When, at the end of 1806, he received orders to proceed to Bombay, he chose the route by Palestine and Syria, disguising himself as a Mameluke for the long journey. He had studied the part so well, and his Turkish was so perfect, that he was received with deference in every town of the Ottoman dominions through which he

passed, and "was able to go to any place and attend any ceremony where only the most jealous Mohammedans were allowed to enter." He stayed at Damascus, and apparently at Aleppo, Diarbekr, and Mardin on his way to Mosul, going thence by the Tigris to Baghdad. From Basra he sailed for Bombay, arriving in September 1807.

Before he left England, Rich had been recommended by Robert Hall of Bristol to Sir James Mackintosh, with whom he had corresponded during his travels. Sir James was at this time Recorder of Bombay, and Rich was at once invited to stay at his house—a fateful visit which led to his marriage with the eldest daughter, Mary, a clever, high-spirited girl who shared his tastes for the arts, learning, and adventure. In January 1808 Claudius Rich, in recognition of his unique knowledge and experience in Eastern affairs, was appointed as Resident at Baghdad, and within a few weeks the bridegroom of not quite twenty-two and the bride of eighteen were on their way in an East Indiaman, one of a convoy under the protection of the British Navy, for the Persian Gulf was infested by Arab pirates, and British shipping was also in danger from French men-of-war and privateers. Reaching Basra in six weeks, they sailed slowly up the Tigris in the Residency yacht, arriving at Baghdad in May.

At this time France was in the ascendant throughout the Ottoman Empire. Napoleon was held to be invincible, and Baghdad was regarded as his future headquarters whenever he should march to the conquest of India. French agents and spies swarmed in Turkey and Persia, and in Baghdad, the junction for Eastern travel and trade. Rich entered on his new work in strange and troubled conditions. He lost no time in arranging communications by Tatar couriers from Constantinople, *via* Baghdad, to Basra; and a system of agents and posts, "often of a very secret nature," in the chief towns of Asia Minor, the Caucasus, Syria, and Persia. It was his business also to collect European news for the Bombay Government, to make précis of the contents of the Frankfort journals or English newspapers, and despatch them by courier to Basra for mail-ships to India—the quickest route then available, though taking three or four months.

Politically, Baghdad was in a state of chaos, a centre of intrigue, faction, and violence. But Rich, with his "singular power over the Oriental temperament," upheld English prestige against all opposition, gaining great influence among Turks and Arabs, while "the wonder of his integrity and justice" was known even in the Porte itself. Rich's chief solace in his anxious work lay in reading and collecting antiquities. During the first three years at the Residency he studied ancient and Oriental history, Mohammedan Law, and Turkish and Arabic dialects; also carrying out a survey of Babylon and other ruins. He was intensely interested in all geographical matters. At that time "no trustworthy maps existed of Mesopotamia, or indeed of Western Asia," but, on hearing that an Englishman, Major Rennell, had surveyed Persia and parts of Arabia, Rich wrote an urgent request for his maps to Bombay. He lost no opportunity of making measurements, plans, drawings, and maps on his various expeditions, in preparation for the 'History of Western Asia' which he hoped to write.

After several hot seasons in the trying climate of Baghdad, Rich was so much out of health that he applied for leave, and in October 1813 he and his wife, who was dressed as a Tatar youth for greater safety and comfort, set out for Constantinople with a travelling party of several armed men and servants, and twelve post-horses. They took the route by Kifri, Tauq, and Kirkuk to Mosul, covering from 25 to 45 miles in a day, and halting each night at the khan or with the chief resident of the village. After three days' stay in the Catholic Convent, the Pasha provided them with an escort, which was increased by a strong body of Tai and

Girgiree Arabs at Eski Mosul, and under their protection the travellers crossed the Shammar Desert in safety.

From Nisibin they proceeded to Mardin in the Kurdish hills, where Rich had a severe attack of his recurring illness, which seems to have been malaria. At the end of a week he was able to continue the journey, though scarcely fit for the long rides, often by dangerous roads or mountain passes in wintry weather, which still lay before them. Pausing at Diarbekr, Arghana Ma'aden (the centre of copper-mines), Malatia, and Sivas, they came to Tokat, in its beautiful setting of mountain and valley, where Rich ordered a stone to be engraved with a Latin inscription for the grave of Henry Martyn, who had died there in 1812. Plague was rife in many of the Anatolian villages, and the travellers pressed on to Boli, arriving on Christmas Eve. The dangers and hardships of their 1500-mile journey only ended at the New Year, when, frozen and exhausted, they entered the British Embassy at Constantinople.

The chapters which describe the Richs' European tour, 1814–1815, are specially interesting. They stayed in one capital after another, witnessing the making of history in those eventful years; and the news of Waterloo reached them at Venice when they were on their way back to Constantinople. The return journey was varied by taking the Angora–Yozgad route to Tokat, and by visits to the ruins of Dara and Nimrud. While at Mosul, Rich busied himself with taking a survey of the neighbouring places, and fixing the latitude of Mosul, then inaccurately given on such maps as existed.

In the spring of 1817 Rich made a second expedition to Babylon in order to test and correct the theories he had formed on his earlier visit and described in his 'Memoir on Ruins of Babylon' (1815). Three years later Rich escaped from the summer heat in Baghdad by a journey into Kurdistan, exploring mounds and ruins on the way, and making the map which appeared in his 'Narrative of a Residence in Koordistan' (1836). The Richs spent over two months in Sulimania on this occasion, as the guests of the ruling Pasha, gathering much information from the Kurdish chiefs about this almost unknown country. Later in the year Rich's party penetrated into the eastern mountains as far as Sinna, in Persian Kurdistan; and during a four months' stay at Mosul he explored, measured, and mapped the mounds covering the site of Nineveh.

The later years of Rich's life in Baghdad were clouded by frequent illness, financial anxieties, and the hostility shown by Daoud Pasha, a suspicious and tyrannical ruler. In May 1821 he extricated himself with honour from a position which had become impossible, and left Baghdad. Sending on his wife to await him at Bombay, he remained at Bushire, expecting definite orders from the Company; but finding the heat of the port intolerable, he set out with two friends to Shiraz. While there he attained his great desire to visit Persepolis. Within six weeks of his return to Shiraz the town was stricken with a terrible outbreak of cholera, and Rich, weakened by constant fever, was unable to resist its attack. He died on 5 October 1821, when only thirty-five.

Claudius Rich was not only a pioneer in archæology and allied studies, but an administrator of rare ability. His personality and work deserved this biography, which will appeal equally to all who are interested in Near Eastern exploration, and to those who are working for the establishment of the new nation of 'Iraq.

M. K.

MUSIL'S ARABIAN JOURNEYS

THE NORTHERN HEGÂZ. ARABIA DESERTA. THE MIDDLE EUPHRATES. By ALOIS MUSIL. (Oriental Studies and Explorations, 1, 2, and 3.) *New York: American Geographical Society* 1926–7. 10×7 *inches;* xii+374, xviii+631, xv+526 *pages; illustrations and maps. V.* 1, $7; *V.* 2 *and* 3, $8 *each*

HAD these journeys been described soon after their accomplishment—that is to say in 1915—they would have attracted a good deal of attention. In those days the Syrian Desert and Northern Arabia were considerably less known than they are now, and had a greater air of mystery. Their romance largely disappeared with the arrival of motor car and aeroplane; and even desert warfare is not the game it was.

But in 1908 the great triangle bounded by Aqaba, Aleppo and Basra was comparatively new ground, and for large areas of this Musil is our only informant. The details of his explorations would have been a great addition to the material for the compilation of Arabian maps which have appeared during the last twelve years, but the reports of these journeys, which extended from 1908 to 1915, have been withheld until now, when they appear in the form of a series of five volumes issued by the American Geographical Society.

Musil's travels fall naturally into these five divisions in which they are published. 'The Northern Hegâz' treats principally of the Hisma highlands between the Red Sea and the Hejaz railway, from Aqaba in the north to Tebuk in the south. 'Arabia Deserta' describes the Syrian Hamad between Damascus, Jauf and the Euphrates; it includes the Wadi Sirhan and the western limits of the Nafud to within sight of Taima. 'The Middle Euphrates' covers the valley of the Euphrates from Aleppo to Baghdad and Najaf. 'Palmyrena' (to be published) will describe his journeys over the North Syrian Desert, between Homs, Palmyra and the Euphrates. 'Northern Nejd' (also to be published) will describe his journey to Jebel Shammar in the early days of the War before the Arab revolt crystallized. Musil—the Czech Professor of Oriental Studies at Prague—was wandering between Mesopotamia and the Hejaz railway in the winter of 1914–15 when the conflict took place between Ibn Sa'ud and Ibn Raschid.

The first volume of this series to be published is dated 1926, and relates to journeys made in 1910, between Aqaba and Ma'an, through the land of Midian to Tebuk, and southwards of the Wadi Jizzil. Burton is our only authority on this region, but it is a land of great interest—ancient and modern. It contains some of the most romantic scenery in Arabia, including the famous Wadi Rumm, which even stirs the imagination of the unsentimental Bedawin. It is also the home of the famous Howeitat, and Musil records stories of their fighting chief—the great Auda abu Tayi—which almost equal those grim accounts given by Lawrence. After describing in detail his itineraries and experiences at the Bedawin encampments, Musil reserves the remaining third of the volume for Appendices chiefly relating to historical identifications—Biblical and early Muhamadan.

Vol. 2, published in 1927, describes in 474 pages Musil's journeys in 1908, 1909, 1912 and 1914–15 over what he calls "Arabia Deserta," but which we are accustomed to know of as the Syrian Hamad or Syrian Desert. Desert it is, but Syrian rather than Arabian, for no less an authority than the late Dr. D. G. Hogarth delineates the boundary between Syria and Arabia at the 30th parallel of latitude—a line drawn roughly from Aqaba to the head of the Persian Gulf, and says that Jauf itself is Syrian rather than Arabian. Musil made one excursion south of this, along the western side of the Nafud to within sight of Taima. A

considerable part of the volume deals with the Wadi Sirhan—ground already well trodden, and since his visit again carefully mapped by Philby and Holt.

More important are his wanderings over that curious region of lava-flow and high ground to the north-east of the Wadi Sirhan—the very heart of the Hamad where rise the waters which flow to the Euphrates. This region we knew nothing of before, and little has been added since. It lay, in those pre-war days, a great white blank on the maps between the Wadi Sirhan and the routes of those travellers who passed from Damascus to Mesopotamia, or such as Leachman, who made a circuit of it on his way to Central Arabia. Yet here lies the watershed of the Syrian Desert, a rolling high ground attaining 3300 feet in altitude. Musil suffered from bitter cold, snowstorms, and frozen water-skins. Here are the sources of the great Wadi Hauran and other affluents of the Euphrates, which rise, not as Arab report had it on the Jebel Druze, but on the Jebel 'Aneiza and Laha, the most important divide in "Arabia Deserta."

Vol. 3, 'The Middle Euphrates,' published in 1927, describes journeys up and down the valley of the Euphrates between Raqqa and Najaf, with excursions to Baghdad and Tekrit, between the years 1912 and 1915. Appendices occupy half this volume, and relate to Musil's favourite theme—the identification of historical sites, and the routes of early conquerors of Mesopotamia, such as the route of the Ten Thousand along the left bank of the Euphrates; the march of the Emperor Julian in 363 A.D.; Khaled's campaigns along the Euphrates in the seventh century. All Moslem geographers are quoted from Khurdadbih (864) to Ibn Batutah (1355). The canals, ancient and mediæval, of the Middle Euphrates are traced, and the rivers of the Garden of Eden identified.

The results of Musil's topographical work are shown on two important maps issued with these volumes, namely a map to illustrate the "Northern Hegâz," on the scale of 1 : 500,000 or 2/M, which covers the region between the Red Sea and the Gulf of Aqaba and the Hejaz Railway, from Ma'an in the north to El Ala in the south; and four sheets on the 1/M scale of Northern Arabia to accompany his 'Arabia Deserta.'* There is also a map of "Southern Mesopotamia" on the scale of 1/M, relating only to the land between the two rivers *above* Baghdad. These maps allow no blank spaces; every spare inch is filled up with carefully contoured surfaces, every physical feature being labelled with its name. This is misleading, for there are no means by which one can distinguish fact from fancy, the "surveyed" from "native report." Too much attention has been paid to information gathered from native sources, and too little to the work of previous travellers. No reference is made to any of Musil's forerunners (except a passing mention of Burton and Hüber), yet there were many; but none of their work has been incorporated in his maps. Mr. Reeves' opinion is that "when compared with previous maps of the region it will be seen that much new mapping work has been done, though necessarily a great deal of this is of a sketchy nature, obtained at times from native information. It is to be regretted that in the compilation and adjusting of both of these maps better use has not been made of the maps and astronomical determinations of other travellers, which to a great extent have been ignored. Still, they constitute a valuable addition to the cartography of this region, although they require considerable revision, readjusting, and combining with other work."

In a note on p. xv of the preface to 'Arabia Deserta' Musil says, "except for the observations of Hüber in the region south of the Nefud, no other explorer's

*The map covers a larger area than the region described in 'Arabia Deserta.' It reaches from the Euphrates to the Syrian and Palestine borderlands, extending as far north (nearly) as Aleppo, and as far south as Jebel Shammar.

data were of use to me in the construction of my map of Northern Arabia," whereas if he had utilized the very good surveys made by Shakespear and Gertrude Bell—to mention only two—it would have added largely to the perfection and value of his map. Where Musil based his conclusions upon Hüber's material, he says he consistently used his original notes, instead of the misleading sketch-maps compiled from them in Paris. All this had already been done by the R.G.S. in 1915–17. The whole of Hüber's last journey (1883–84), when he was ten and a half months in Arabia and covered some 3000 miles on camel-back, was replotted by the Society from his original daily observations.

Nor is any attention paid to the astronomical observations made by previous travellers; yet the "List of Astronomically determined Positions in Northern and Western Arabia up to November 1918" is obtainable from H.M. Stationery Office, and includes even the positions on the Hejaz Railway determined by wireless signals from Paris and Berlin (compiled for the G.S.G.S. by D. Carruthers and E. A. Reeves). Also the string of positions fixed by Major Holt between 'Amman and the Euphrates seem to have been ignored, yet these astronomically determined positions, depending on wireless signals from the Eiffel Tower and Nauen, cannot be superseded.

After reading the masterpieces of Burton, Doughty, the Blunts and Lawrence —all saturated with the romance of the tribes and the glamour of the desert, these cold and colourless descriptions fall rather flat; one hardly recognizes the same regions as described by Doughty and Musil. In truth, the work is a compilation of facts, as noted in a traveller's hastily written diary, without human sympathy, without local colour, and utterly devoid of any atmosphere. This may be due to the fact that the account is published many years after their experience; yet consider Doughty's epic written up—"from a sheath of notes he carried in his bosom"—ten years after he returned from "the lion's den of Islam"!

D. C.

Note.—The fourth volume, 'Palmyrena,' has appeared since the above was written.

ALPINE VALLEYS OF ITALY FROM SAN REMO TO LAKE ORTA. By E. L. BROADBENT. *London: Methuen* 1928. 8×5 *inches;* xii+244 *pages; illustrations and map.* 7*s* 6*d*

MISS BROADBENT'S wanderings, as here described, extend from Ventimiglia to Varallo. With the exception of the Ligurian valley of the Roja they lay therefore in Piedmont, and she might have done better to take the Simplon as her limit and for her title 'The Valleys of Piedmont.'

Miss Broadbent's principal object would seem to be not so much to tempt her readers by sketches of travel or pictures of scenery as to inform their minds by collecting information, historical and artistic, about the localities visited. For facts of every description she has an unquenchable appetite; in their quest she has dipped largely into literature both general and local, and she pours out in her pages the result—a medley of miscellaneous information. It is apt to be at once detailed and fragmentary, and proves in places open to criticism. We cannot, for instance, accept her statements as to the orography of the Monte Rosa group, or her arguments as to Hannibal's Pass. But her account and inventory of some of the old castles of Val d'Aosta, too little known to English tourists, was worth publishing, and we would not endorse the unkind suggestion of the owner of one of them, who dismissed his visitor with the remark that enough books had been written about the valley, and there was no call for another! On Aosta itself and its connection with Anselm Miss Broadbent has much to say, and its antiquities deserve more attention than they generally get from passers-by.

The authoress is no climber and systematically respects the snow-level. But she has ventured into districts as to which the main source of information for most English travellers has been the work of an author she more than once shocks us by grotesquely referring to as "Balls"! She has penetrated in the Maritime Alps to the delightful groves of the Certosa di Pesio—no longer, alas! open as an inn—and the flowery meadows of the Col de l' Argentière. She has visited the shrine of S. Chiaffredo and the sources of the Po, and the sanctuaries, Oropa and Graglia, that adorn the hills of Biella. She describes Cogne, once the remote happy hunting-ground of Victor Emmanuel, but now an Alpine retreat approached by a motor road and reserved for the military exercises of Italian militia. Miss Broadbent's book is well indexed and illustrated with some pleasant snapshots of rustic figures.

AMONG THE ALPS WITH BRADFORD. By BRADFORD WASHBURN. *New York and London: G. P. Putnam's Sons* 1927. 8×5 *inches;* xiv+160 *pages; illustrations.* $1.75

This, as the sub-title adds, is "an American boy's story of his summer-time climbing experiences among famous Alpine peaks." The breeziness of the narrative, and the enthusiastic spirit in which it is written, render it, in its way, quite an attractive little volume.

It is chiefly concerned with a partial ascent of Mont Blanc and the traverse of the Charmoz–Grépon Aiguilles ridge from Chamonix. The writer claims to have made several "first ascents" in the range dealt with, but gives no indication of their identity nor of the nature of the climbing involved. The main purpose for which the expeditions were made is stated to have been to obtain photographs and "motion pictures" of the youthful author in action, and many of these are quite useful as affording illustrations of the technique of difficult rock-climbing in this region.

A glossary of the many and characteristic Americanisms in which the book abounds would help to render it more readily intelligible to the ordinary English

reader. On the "jacket" we find quoted the observation of an American father to the effect that "I asked my twelve-year-old son what he thought of it. 'It's a humdinger,' he said." Now, what *is* a "humdinger"?

SIR JOSEPH BANKS AND ICELAND. By HALLDÓR HERMANNSSON. (*Islandica* vol 18.) *Ithaca, New York: Cornell University Library; London: Humphrey Milford, Oxford University Press* 1928. 9×6 *inches;* xii+100 *pages; 3 portraits and 24 illustrations.* $3

In the year 1772, when his arrangements for accompanying Cook on a second voyage to the South Seas fell through, Banks, who had collected a staff and made expensive preparations for that enterprise, resolved to employ them in an expedition to Iceland, probably induced thereto by Dr. Solander, the Swedish botanist who had been his colleague on Cook's first voyage. No consecutive account of his six weeks' stay in the island has come down to us. His own journal has been lost; but it was probably used by von Troil, another Swede who accompanied Solander, Banks, "and several other Literary and Ingenious Gentlemen," and afterwards published his 'Letters from Iceland' (the title of the English translation of 1780) which makes interesting reading though it is a general description of the island rather than a narrative of the expedition. Sir W. J. Hooker actually quotes from the journal in his account of the tour that Banks persuaded him to make in Iceland in 1809. We know that Banks landed at Hafnarfjörður, visited Thingvellir and Skálholt, saw the great Geysir throw up a spout 92 feet into the air, and could not sit down on the summit of Hekla for the heat of the rocks. The tangible results of the journey took the form of botanical specimens and a number of Icelandic books and manuscripts that were given to the British Museum; and honourable mention must be made of the drawings of volcanic scenery and native dress by John and James Miller and John Cleveley, two dozen of which, reduced and without colour, are well reproduced at the end of the present volume.

But the real importance of the 1772 visit both to Banks and to the Icelanders was the lifelong friendship established between them; and that is the main theme of the present book. Troublous times were in store for the distant dependency when Denmark was involved by the Tsars in hostilities with England. Banks warmly advocated the annexation of Iceland and its delivery from the "Egyptian bondage" of the Danish trade monopoly. However, the treaty that followed Parker's and Nelson's victory at Copenhagen in 1801 put a temporary stop to such a scheme. War broke out again in 1807 with disastrous results to Iceland's trade. Some Icelandic merchantmen having been captured and detained at Leith, Banks strenuously pleaded with the Government for their liberation. Then followed Gilpin's piratical raid of 1808 and the extraordinary episode of the so-called Icelandic Revolution of 1809, engineered by an English soapmaker named Phelps and a Danish prisoner of war named Jörgensen, who seized the Danish Governor, Count Trampe, and committed other enormities. Banks' inquiries led him to the conclusion that "Jörgensen is a bad man, Phelps as bad, and that Count Trampe is a good man, as good I mean as Danes are when they are good, which is by no means as good as a good Englishman." Through his exertions an Order in Council was issued strictly forbidding all acts of hostilities against the Danish Colonies. But Banks could never persuade the Government that the annexation of Iceland was a paying proposition, and, as our author points out, there was no real animosity in England against Denmark. Many of Banks' letters and other papers are given in full; all exhibit a deep affection for "our little island," and it is clear from other writings that he was not without honour there. J. H. R.

GREECE. By W. R. MILLER. *London: Ernest Benn Ltd.* 1928. 8×5 *inches;* vii+351 *pages.* 15*s*

Recent events, physical and political, have justified the author's words: "To write anything final on contemporary Greece is a task somewhat resembling the web of Penelope." Nevertheless, Mr. Miller's study of the eddying forces which have shaped the Greek nation since 1821 is a worthy addition to a series already recognized as "indispensable."

Modern Greece has undergone such intricate and rapid evolution that the ordinary reader, skimming the record in the daily press, can neither correlate nor remember its phases. Only an observer on the spot, in close touch with the chief actors in the State, could have produced this lucid account of the country and people. Mr. Miller has also the advantage of long familiarity with the mediæval history, the folk-lore and the literature of Greece; and he has discovered that "the best way to understand the ancient Greeks is to live among the moderns." His intimate knowledge of past and present is set out in this volume, "without conscious partisan bias or prejudice," though the author's sympathy with the aims of New Greece is evident. His own hopes for the nation's future are based on its extraordinary recovery from military and economic disaster, and on the successful settlement of 1,500,000 refugees who have thronged into the country, from various sources, since 1921. Unlikely though it seemed, these have proved an asset in Greece's development, extending agriculture, and creating new industries in the towns.

Mr. Miller mentions that the first Greek railway was opened as late as 1869. This short line, from Athens to the Piræus, was doubled in 1893 and electrified in 1904; it now has a service of 230 trains daily. The whole system covers 1609¼ miles, but "all the Greek railways are on the mainland; no Greek island, nor even Crete, has a mile of railway;" and until May 1916 there was no connection by train with "Europe"—as the Greeks still call it.

Less than a hundred years ago Athens had no carriages nor carts; heavy loads were carried by camels, as, to this day, they are on the Itea–Salona road. The streets of the capital are now crowded with motors; and travel in Greece has become easier and quicker by their use—though driving roads are still lacking in many parts. Greece holds the same place in the world's shipping as before the war; and an Italian air service has recently been started from Brindisi *via* Phaleron to Constantinople, for mails and passengers.

A map of post-war Greece, showing its new boundaries and the railways, would be a valuable addition for the general reader and the student. M. K.

PERSIAN PICTURES. By GERTRUDE BELL, with a Preface by Sir E. DENISON ROSS. *London: E. Benn Ltd.* 1928. 9×6 *inches;* 198 *pages.* 10*s* 6*d*

Fifty years ago in the days of Queen Victoria a traveller in the Near East might, in the crowded bazaars of Cairo, or among the bare hills of Palestine, come across figures that seemed to have stepped out of the Bible pictures of his childhood. But the picture was seldom complete. A shabby Levantine, or perhaps an incongruous tourist, or Russian pilgrim, was apt to step in and destroy the illusion. But the few, who went on farther east to Persia, might hope to enjoy to the full a daydream of having been transported into the local atmosphere and among the company of the Arabian Nights. They were all there, the familiar figures, among the black-capped and long-coated crowd that flit along the shady corridors of the bazaars, lit here and there by sharp shafts of light that pierce through the frequent holes in the brick domes. Some may stop to chaffer with the merchants who sit above their merchandise in their niched shops under the central halls, where two arcades cross; but the general air of the passers-by is one of active life, of restless motion; the scene one of shifting colour and shadow.

Gertrude Bell's 'Persian Pictures' have this quality of high art, that to some elderly readers they will bring back in their original vividness precious memories they had fancied for ever faded. In these short chapters a mind quickly responsive to the sights and incidents of travel, its sensations and suggestions, is reflected in a style that has all the vigour and enjoyment of youth with none of its crudity. The author has been captured by the spirit of the East; she seizes on its landscape and life in their most primitive and picturesque details. A faithful picture of Persian landscape and of the hardships of travel is conveyed to her readers. They have brought before them, in turn, the brown treeless mountains that gird the horizon; the oases, which are towns or villages embowered in groves, and ringed by gardens where the roses bloom among a labyrinth of water-channels.

Miss Bell was born with a talent for description both of the road and of the people on the road, which the public first realized in the pages of 'The Desert and the Sown.' It shows itself equally whether she is describing her visit to her uncle, Sir Robert Lascelles, when our Minister at Tehrān, or her later climbs in the wilds of Dauphiné. We are grateful for anything from her spontaneous and fortunate pen. Sir E. Denison Ross, who introduces this reprint of 'Persian Pictures' by an interesting preface, has done well to reprint with it a characteristic account of Miss Bell's first impressions of Tehrān, written to one of her relatives, which had already been included in the two-volume edition of her Letters. D. W. F.

A PERSIAN CARAVAN. By A. Cecil Edwards. *London: Duckworth* 1928. 9×6 *inches;* 166 *pages;* 8 *illustrations.* 8*s* 6*d*

Now and again a European is born who can, as it were, enter into the skin of the Oriental and present him to the West. Such a one was Morier, in his masterpiece 'Hajji Baba of Ispahan,' and the reviewer remembers lending the book to an educated Persian who returned it half read. He explained that the story had no interest for him and he could not imagine why it had been written, because everything in it was merely what Persians said or did any day of their lives.

And now Mr. Edwards appears to reveal to us anew the mentality of a Persian Governor, of a great Mullah, of a merchant or of a servant. His 'Persian Caravan' brings back to the mind of any one who has travelled in Iran picture after picture of its likable people and of a country, half desert though it be, that has a strange and enduring fascination.

These entertaining sketches are full of wit and humour, with an undercurrent of tragedy that rises now and again to the surface. Mr. Edwards is no Orientalized European concerning whom the Persian proverb runs: "There was a crow that tried to walk like the partridges, but in imitating their gait he lost his own and could never copy theirs." He holds the balance true, and the book ends with the thrilling tale of how the wit of one Britisher and the dogged courage of another, helped by a most resourceful driver, staved off disaster from the Bank at Meshed. The reproductions of some beautiful Persian miniatures do much to help the atmosphere of a delightful and revealing book. E. C. S.

THE PERSIAN GULF: An Historical Sketch from the Earliest Times to the Beginning of the Twentieth Century. By Lieut.-Col. Sir Arnold T. Wilson, K.C.I.E., etc. *Oxford: Clarendon Press* 1928. 9×6 *inches;* xii+328 *pages; illustrations and map.* 25*s*

Many as have been the books published within recent years on the Persian Gulf and its surrounding regions, the appearance of the present work is of import-

ance, for whereas most of the others have been confined to some more or less narrow aspect of its history or geography, Sir Arnold Wilson here gives us the best, if not actually the first, historical review of the development of the Gulf regions as a whole from the earliest times to the beginning of the twentieth century. It therefore deserves a warm welcome.

The first chapters of the book show the Babylonians as the earliest civilized race to frequent the Gulf, probably under the influence of their great King Sargon, *c.* 2872 B.C. They were followed in due course by the Assyrians and Persians, but the first event of real importance is the voyage of Alexander's admiral, Nearchus, with a fleet reputed to have consisted of 1800 vessels, from the Indus to the Tigris, in 326 B.C. Sir Arnold has some interesting comments on the identification of the abstruse place-names mentioned in the narrative of the voyage. The chapters which follow give us an interesting sketch of the history of the Gulf in the Middle Ages, and show us successively the rise of Siraf, Qais, and Hormuz to prosperity, and their subsequent decline and fall. These accounts are of course largely compiled from those of other writers, mediæval Arab travellers for the most part, but Sir Arnold uses his sources judiciously and presents a coherent view of the whole. He touches on the remarkable expansion of Chinese seaborne trade to the Gulf ports, and identifies many of the forgotten but once famous cities on its shores.

With the coming of the Portuguese in 1508 we are on firmer ground, and history takes on a livelier and more romantic aspect. The Portuguese are often accused of ruining the commercial prosperity of Hormuz by their rapacity and extortions; but this accusation cannot be applied with justice to the early years of their domination, and even so late as 1583 Ralph Fitch gives a glowing account of the flourishing state of the town, whilst from Monnox's description of the city at the time of its capture by an Anglo-Persian force in 1622, we see that even in its decay it could still claim to be the "jewel in the ring of the world"; nor should it be forgotten that during their tenure of power in the sixteenth century, the Portuguese kept the Gulf free from the curse of piracy, in the same way as we are keeping it to-day.

After the destruction of Hormuz, Bandar Abbas grew to be the chief commercial centre of the Gulf, and the Dutch and English supplanted the Portuguese in the mastery of the sea—although the latter did not finally disappear from the scene until the middle of the eighteenth century. Sir Arnold Wilson gives us a much fuller account of the doings of the Dutch in this region than have most other writers, and especially interesting is his description of Baron Kniphausen's ill-starred adventure on Kharag, where he had a fort garrisoned by one hundred Europeans, "all neat, handsome fellows, kept under the stricktest discipline," together with more than "a hundred Coffree slaves."

During the eighteenth century the British gained the upper hand over their Dutch rivals, and gradually began to assume that sea supremacy in the Gulf which has lasted with such beneficial effects down to our own times. It is instructive to note that the East India Company embarked only slowly and unwillingly upon the policy of putting down the pirates which so long infested the Gulf. For a long time the orders given to the ships' captains were to avoid fighting save in the last extremity of self-defence; not unnaturally the pirates treated this forbearance as a sign of weakness, and attacks on English vessels became increasingly numerous. Even then the Company was loth to take forcible measures, but the capture of the *Minerva* in 1808, and the barbarous slaughter of the ship's crew, finally stung the Bombay authorities to action, and a series of expeditions against the pirate strongholds was inaugurated, which eventually led to their destruction.

The abolition of the slave trade proved an even more difficult matter than the suppression of piracy, and considerable friction was caused at times with foreign powers owing to the gross abuse of European (chiefly French) flags by the Omani slavers. As Sir Arnold puts it, "British men-of-war had to see slavers plying with impunity under the protection of a flag on which red, white, and blue—in the Gulf at all events—stood for something different from Liberty, Equality, and Fraternity." However, with the inauguration of the "Entente Cordiale" the position was considerably improved and the traffic is now practically wiped out.

Although this book is admittedly an historical rather than a geographical work, it is a pity that Sir Arnold Wilson has not told us more about the interesting, if unpleasant, characteristics of the geography and climate of the Gulf; for these must have had their share in moulding the character of the fierce and lawless tribes who inhabit its shores. As it is, this want is supplied in some measure by the excellent photographs which accompany the text and give us a good idea of the scorched and rugged grandeur of some parts of the coast.

The book does not pretend to be more than a compilation, but the work of selection has been judiciously carried out, and mistakes are singularly few. Plate XIII(*a*) is obviously wrongly attributed (unless painted at Ormuz in the Ice Age!), the date of Solebay (p. 167) given as 1676 should be 1672, and Sir Arnold's version of the first Dutch war in the Gulf contains several errors, but these are only minor slips, when the book is viewed as a whole. There is a very full bibliography and an excellent index.

A study of this work cannot fail to bear out Mr. Amery's statement in his Foreword: "Our record in the Gulf will bear the closest scrutiny. We have worked, not for ourselves alone, but for all nations. . . . We have been content to place our energy and enterprise into free competition with those of others, and to abide by the result. We can survey a century's work with a stout heart and a clear conscience." To which it might be added that Sir Arnold Wilson is not the least of those who have enabled us to do so. C. R. B.

TRAVELS IN TARTARY, THIBET, AND CHINA (1844–6). By E. R. Huc. Translated from the French by W. Hazlitt. With an Introduction by Paul Pelliot. 2 volumes. The Broadway Travellers Series. *London: George Routledge & Sons, Ltd.* 1928. 9×6 *inches;* V. 1, xliv+387 *pages;* V. 2, viii+406 *pages; and a map.* 25*s*

The record of the famous journey made by the Lazarist missionaries, Huc and Gabet, through Mongolia to Lhasa deserves a place in this fine series of travel books, and the editors have done well to keep Hazlitt's admirable translation unimpaired. It has not been reprinted in full for many years, although a new French edition was issued from the Imprimerie des Lazaristes, Peking, in 1924, edited by J. M. Planchet. Unquestionably Huc's 'Souvenirs' have everything which goes to make a great book of travel. They are the record of a journey which lasted eighteen months through country which at that time was almost unknown to Europeans: as Professor Pelliot might have mentioned in his introduction, no white man followed the missionaries until 1921, when the late Brigadier-General George Pereira succeeded in entering Lhasa from the east. Then the journey was one of almost unremitting hardship and danger; the caravan consisted of no more than three camels, a white horse and a black mule, with a couple of portmanteaux for personal baggage and a single cameleer for staff. And even more than this, the narrative itself has just those qualities of vividness and readability which are essential to make it live: those graphic touches, reported snatches of conversation, and intimate discursiveness which make it comparable with 'The Bible in Spain.'

Professor Pelliot supplies the modern transcription of the Chinese, Tibetan, and Mongol names in the text, and his introduction is scholarly, critical, and informative; he gives a sketch of Huc's and Gabet's careers; does not hesitate to show how Huc trimmed his narrative for public consumption, and discusses the debated question as to what induced the missionaries to penetrate as far as Lhasa. He proves, we think conclusively, that this was in the nature of an accident. There is no doubt that their instructions sent them to outer Mongolia with a view to founding a mission among the nomads. Yet Huc, when not ambiguous, definitely asserts that Lhasa was their objective from the start. Gabet, on the other hand, speaks of their détour to Lhasa as an accident. Professor Pelliot considers that "we must attribute to a combination of fortuitous circumstances the changes in the itinerary which, leading them to the south-west, eventually brought them to Lhasa," and suggests that the welcome the fathers received on their return to Canton turned Huc's head a little, and that, not wishing it thought that he had become a great traveller by accident, he let it be supposed that they had gone to Lhasa as a result of mature deliberation in the beginning. Such a conclusion is certainly in keeping with Huc's temperament and may well be the true explanation.

The two volumes are well indexed and handsomely produced, but they have one grave defect: the map is quite inadequate. It is on far too small a scale and shows few of the places mentioned in the text; while the spelling does not correspond either with Huc or with the scientific transcription. It would surely have been possible for the editors to have provided a map for each volume which would have enabled the reader to follow each stage of the journey as it is described. Their omission to do so is a serious blemish on a production for which, otherwise, there can be nothing but praise. O. R.

A RELATION OF A VOYAGE TO GUIANA BY ROBERT HARCOURT. Ed. by Sir C. ALEXANDER HARRIS, K.C.M.G. Hakluyt Society, Second Series, Volume 60. *London* 1928. 9×6 *inches;* xii+192 *pages; illustrations and maps*

In editing for the Hakluyt Society this early narrative dealing with British colonization in Guiana Sir Alexander Harris has carried out his task with painstaking accuracy, and the result is a volume which will be of real use to all who are interested in the origin and growth of imperial development as well as to students of the geography and ethnology of Guiana.

It was, however, unfortunate that the editor remained in ignorance of Dr. J. A. Williamson's standard work, 'The English in Guiana, 1604–1668' (published in 1923) until after he had completed his introduction. He would have been able therewith to strengthen the historical section of his introduction, which, as it stands, can hardly be regarded as adequate. Harcourt's 'Relation' is slight in actual size, but it constitutes a document of the first importance for overseas expansion in the early seventeenth century, and therefore merits more detailed treatment, from the historical side, than it has received in this edition. There are, for example, references to Harcourt in the Privy Council registers, the High Court of Admiralty Examinations, and other State papers in the Public Record Office, which it would have well repaid Sir Alexander Harris to examine. No serious student can afford to ignore the Record Office.

The chief importance of Harcourt lies in the fact that he played a notable part in the transitional period during which the English slowly turned from buccaneering and the pursuit of such will-o'-the-wisps as El Dorado to the more sober and more fruitful gains of trade and settlement. The present editor would have us believe that Harcourt was solely bent upon these latter aims and held in contempt the contemporary mania for "mountains of gold." Such a view would

seem to clash with the evidence. Harcourt, it is true, aimed at the founding of flourishing communities in Guiana, and the discovery of precious metals was a secondary consideration, yet, none the less a consideration not to be ignored. In this respect a passage of his own is worth quoting: "I made triall of a piece of sparre, which the same Indian discouered unto me, and I found that it held both Gold, and Silver, which (although it was in small quantity) gave mee satisfaction that there bee richer Mines in the Countrey to bee found: but the best lie deeper in the earth, wee had not time nor power to make seerch for them" (p. 108). Furthermore, the fact that Harcourt took the trouble to send his cousin Unton Fisher on an expedition in search of Raleigh's Manoa, the supposed city of El Dorado (the gilded man) is, to say the least, significant. In point of fact, Harcourt was to a large degree Raleigh's disciple. From the great Elizabethan he had derived his plan of an English Empire in Guiana. Raleigh's 'Discoverie of Guiana,' his later essay 'Of the Voyage for Guiana,' and Harcourt's 'Relation' all strike exactly the same note. Gold there may be, and the Inca city of Manoa may exist; but whether that be so or not, the occupation of and settlement in Guiana must be carried forward because of the three great results that will accrue: the extension of Christ's Kingdom, the political aggrandisement of England at the expense of Spain, and the enormous expansion of English commerce. Harcourt constituted an important link between Raleigh and subsequent colonizers, and we could have wished that more attention had been given to this aspect of his work.

In other respects the volume is worthy of high praise. The editor has reproduced some very valuable maps of Guiana, the most important being one by Gabriel Tatton, which (it is shown) was almost certainly framed for the specific purpose of illustrating Harcourt's exploration and settlement. The notes to the text are copious and scholarly, revealing an intimate knowledge on the part of the editor of Guianian geography and ethnology. In Appendix II by a piece of masterly analysis and reconstruction the editor shows that a document in volume 4 of Purchas entitled "Relation of the habitations and other Observations of the River of Marwin and the adjoyning Regions" is a mutilated fragment of a much more detailed report presented to Harcourt and probably written by his cousin Fisher. Indeed, the notes and this appendix alone make the volume a worthy addition to the Hakluyt Society series. V. T. H.

THE LOWLAND INDIANS OF AMAZONIA. By K. G. GRUBB. *London: World Dominion Press* 1927. 10×6 *inches;* 160 *pages, and* 14 *maps.* 5*s*

Mr. Grubb is a missionary, and his survey of the Native Tribes of Tropical South America is animated by the desire to Christianize them. As a matter of fact missions have made little progress (though they were first started by the Franciscans before the close of the sixteenth century), and the greater part of the work is a valuable and interesting ethnological study of the numerous tribes inhabiting the vast region drained by the Amazon and Orinoco. In fourteen maps the distribution of the different tribes is carefully indicated under their linguistic families. The characteristics of these several tribes and their relation to the white population are frequently referred to. Particulars of area, population—(1) Total, (2) Indian, and the percentage of (2) to (1), also the number of Indians per square mile—are given for each state, together with its form of government, resources and products. We believe that no such extensive details about the Indians of Tropical South America have ever been given before, and they will be of great value both to the ethnologist and the geographer. The author has an extensive personal knowledge of the region, and other sources which he has drawn upon are indicated in footnotes. Several appendices are added. One of

them consists of a list of linguistic families, fifty-seven in number, and the tribes composing them. Mr. Grubb calculates that there are altogether quite four hundred dialects and languages spoken by the Indians of the Amazonian region.

The author frequently refers to the lamentable results of the contact of the Indians with the white man and so-called civilization, and his remarks, and still more those of the distinguished traveller, Koch-Grünberg, whom he quotes, make melancholy reading. Many specific instances might be quoted, did space permit.

The book concludes on a despondent note, explaining that the reason why the greater part of his book is devoted to the tribes and their location rather than to the missions is due to the paucity of the latter, only nine having been established among four hundred tribes, and these have met with little success. How far they may be prejudiced by the Indian's first experience of the white man he does not discuss. The numerical decline which goes on among these tribes, he concludes, makes it hard to say that the situation will improve in the future. Indeed, it is difficult to avoid the conclusion that taken as a whole the Lowland Indians of Amazonia are facing sure and gradual extinction which nothing seems able to arrest.

E. A. P.

OROKAIVA MAGIC. By F. E. WILLIAMS. With a foreword by R. R. MARETT. *Oxford: University Press* 1928. 9×6 *inches;* xii+231 *pages;* 8 *plates and a map.* 12*s* 6*d*

For some time past the Government of Papua has realized the important part that anthropology must play in effective and sympathetic administration of primitive races, and this book owes its being to the policy of appointing trained men to study native culture and affairs, the three parts into which it falls having been originally prepared as Anthropological Reports. The first part deals with the Taro Cult, a religious movement which during the last ten years has spread throughout the Orokaiva people of the Northern Division; this cult, from being originally directed towards the placation of the spirits of the taro (the staple food of the Orokaiva), is now translated mainly to the placation of the spirits of departed ancestors, who are believed to control the growth of the taro. The remaining part of the book is concerned with the Garden Culture of the Orokaiva and with Orokaiva Magic. Mr. Williams's work is an agreeable mixture of accurately recorded fact and stimulating deduction and suggestion; and few who have ever attempted to improve methods of native agriculture or horticulture will doubt the soundness of his conclusion when he insists that if the native is to benefit at all from improved methods that are set before him, he must be taught them young and must be habituated to them.

O. R.

THE EARLY HISTORY OF TASMANIA: The Geographical Era, 1642–1804. By R. W. GIBLIN. *London: Methuen,* 1928. 9×6 *inches;* xiv+341 *pages; plates and charts.* 21*s*

In planning the history of Tasmania in three volumes Mr. Giblin has undertaken first the part most difficult of literary presentation. The elements of his problem are these: an island in a remote part of the world, in seas unvisited by regular traders; a number of casual visits by explorers, spread over a century and a half, the expeditions not forming a connected series in origin or plan, and taking Tasmania only as an incident in voyages for more extensive purposes; a very gradual revelation of the coast-line recorded in a series of imperfect charts; and a succession of observations of a primitive race of mankind, now extinct, by persons who lacked the scientific equipment provided by modern anthropology. Material of this sort is not easy to cast into narrative form. If the title is narrowly

interpreted and only the occurrences on the Tasmanian coast are given, the reader must be left in ignorance of many things he would like to know; if the voyages are told at length the author lays himself open to the charge of filling his book with matter that is irrelevant to Tasmania. Mr. Giblin has skilfully compromised. He has given a firm outline of every voyage and has expanded into full detail those parts which lie on and around the Tasmanian coast. Wherever his explorers touch upon the native race, about which every crumb of information is precious, he quotes their own words. He gives biographical sketches of the navigators, and reproduces their Tasmanian charts. Altogether he has handled the subject in a highly competent manner, and if at times there appears to be some lack of concentration, that is inherent in the conditions. There is perhaps one omission which may be complained of, that of a modern outline of Tasmania with which the incomplete early charts might be compared. A parallel subject, although lacking the native element, is that of the Falkland Islands, and readers interested in historical method would do well to compare the present work with Miss Boyson's excellent history of those islands published four years ago.

Mr. Giblin opens with a description of natural conditions and of the Tasmanian race, and proceeds to the Dutch discovery of Australia and the voyages of Tasman and his successors. He does not go into the question of the possible discovery of Australia in the early sixteenth century, although the Dieppe maps provide a puzzle on which the last word has yet to be said. He gives only modified praise to the Dutch navigators. They were not very enterprising, and even Tasman did not rise to the height of his opportunities, although what he did do was done thoroughly and accurately. But in reading these accounts the comparative student is struck with the immense advance in the quality of the historical evidence for the seventeenth-century voyages over that for the fifteenth and early sixteenth centuries. There is no difficulty in deciding where the Dutchmen went and what they discovered, whereas for the earlier period every transaction is dim and controversial. The difference is partly accounted for by the improvement in the technique of navigation and by the greater exactness of the explorers' vocabulary, but it is still more due to the fact that for the earlier adventures the leaders' own accounts are often lacking and their place is supplied by the versions of stay-at-home geographers who had imperfectly assimilated their material. John Cabot's chart of his New Found Land, if only we possessed it, would probably settle its location as conclusively as Tasman's chart indicates the position of Van Diemen's Land.

After Tasman there is a long interval until du Fresne and Crozet touched Tasmania in 1772 and were the first to describe the natives. Tobias Furneaux followed in 1773, and Cook on his last voyage in 1777. Furneaux was a poor surveyor and failed to discover the insularity of Tasmania. Cook, who was in a hurry to push on to the North Pacific, accepted Furneaux's results and made no important addition to knowledge of the country. Phillip and Bligh, in 1788–92, likewise intent on ulterior objectives, did little more. D'Entrecasteaux in 1792 made a new exploration of part of the coast, and his naturalist Labillardière gave an excellent description, by the light of the eighteenth century, of the people; it is a tragedy that they did not survive to meet the scientific eye a hundred years later. Slowly the impression gained ground that there must be a strait between Tasmania and the continent, but it was not until 1798–9, ten years after the colonization of Sydney, that Bass and Flinders cleared up the problem. These two remarkable and unfortunate men are well portrayed by the author, who gives also a sympathetic view of Captain Baudin, sent out by France in 1801–4. His character was so unjustly blackened by his surviving colleagues

that Bonaparte remarked that he had done well to die on the voyage, else he might have been hanged on his return. The friendly scientific intercourse of Baudin's expedition with the English shows how much more civilized warfare was in that time than now. De Caen's detention of Flinders at Mauritius, in a very open arrest, was strongly reprobated by Frenchmen, although it would have passed as a matter of course in our own Great War.

The narrative concludes with the planting of the first settlements in Tasmania in 1803–4. It is followed by Appendices, of which that on the aborigines is especially interesting. The next volume, on the colonization of the penal era, will be eagerly anticipated, for Mr. Giblin's methods prove him capable of dealing justly with that painful and controversial phase of the colony's development.

J. A. WILLIAMSON.

PLANT ECOLOGY. The Distribution of Vegetation in the British Isles, arranged on a Geological Basis. By MARY A. JOHNSTONE. *London and Toronto: J. M. Dent & Sons* 1928. 7×5 *inches;* vi+186 *pages, and illustrations.* 5*s*

The aim of this book is stated in the preface to be to bring together in simple form some of the records made on British vegetation, for the benefit of the younger botanical student, the teacher of geography and the general reader. It contains a number of fine illustrations from photographs taken by various British ecologists and others, a list of references, a black and white outline geological map in a pocket, and a good index.

The major part of the book is taken up with a series of chapters on "Correlation of Vegetation with Geological Structure," in which the distribution and characters of the rock systems represented in the British Isles are described in some detail, with notes on the natural plant-cover and cultivated crops in each case. This means that a good deal of space is devoted to topics the bearing of which on plant ecology is not obvious. Geographically also it involves a good deal of jumping about from one part of the islands to another, and since detailed botanical surveys have only been carried out in parts of the country, the geological descriptions are frequently much more detailed than the botanical ones. For example, the distribution of carboniferous limestone is described in some detail, but notes in regard to its characteristic plant-cover are given only for Yorkshire and Ireland. Finally, the assumption, which underlies the scheme adopted, that there is a real contrast between the plant cover of rocks occupying different places in a systematic classification, apart from the actual structure and composition of the rocks themselves, does not seem justified, even on the author's own showing. We think that the method adopted is a handicap rather than a help, and the ecology of the title tends to be submerged beneath the geology of the sub-title.

M. I. N.

THE CLASH OF CULTURE AND THE CONTACT OF RACES. By G. PITT-RIVERS. *London: Routledge* 1927. 9×6 *inches;* xiv+312 *pages; illustrations.* 18*s*

RACE AND CIVILIZATION. By F. HERTZ. *London: Kegan Paul* 1928. 9×6 *inches;* xii+328 *pages.* 18*s*

THE RACIAL ELEMENTS OF EUROPEAN HISTORY. By Hans F. K. GÜNTHER, transl. by G. C. WHEELER. *London: Methuen & Co* 1927. 9×6 *inches;* 288 *pages; illustrations and maps.* 15*s*

DIE WALDVÖLKER. By G. HÖRNER. Erganzungshaft zu *Petermanns Mitteilungen* 192, 1927. vi+80 *pages. M.*9

WIRTHSCHAFTFORMEN UND LANDSCHAFT. By R. AHRENS. *Hamburg: . Friederichsen* 1927. 11×8 *inches;* xii+98 *pages. M*10

PROCEEDINGS OF THE WORLD POPULATION CONFERENCE, 1927. Edited by Mrs. MARGARET SANGER. *London: Edward Arnold & Co* 1927. 9 × 6 *inches;* 384 *pages.* 20*s*

The question of race and environment is evidently occupying many minds, and this is a natural consequence of the infiltration of the Darwinian idea, for that idea gives us, for the first time in history, a chance of gaining some understanding of how we have come to be as we are. The study has its own pitfalls, not the least of which is the danger of developing too good a conceit of ourselves, of allowing that form of myopia which often calls itself imperialism to upset the balance of our judgment, to see only the good points about the stock to which we belong and to fancy ourselves the best of mankind. This is a defect from which Günther in common with some Americans and Englishmen suffers, and his book is hardly scientific enough to be recommended. At the same time he has every right to be wrathful with some of the violent things said within the last fifteen years about his countrymen, though he need not have imagined feelings of that kind behind Professor F. G. Parsons' well-known observations on the physical characteristics of German prisoners of war in England. Dr. Hertz is a well-known opponent of theories of racial superiority, and his present book is a new treatment of the subject of "Rasse und Kultur" which tried to serve honest thought by combating the follies of H. S. Chamberlain's 'Foundations of the XIXth Century.' It is interesting to have the views on race and history of a thinker who has read widely and tries to be fair; an occasional reference to Hertz is a good safeguard against too rapid generalization on connections between mental and physical characters. For Hertz the German people are at least as mixed as we are in Britain, and, he would add, are, like ourselves again, all the better for it. It may be added that Dr. Hertz' point of view needs to be supplemented by studies of physiological relations between man and environment such as are hinted at in various publications by Dr. Leonard Hill, in papers on the form of the nose by Professor A. Thomson, Mr. Buxton, and so on; and it is more than possible that, by inquiring more deeply into the details of growth and metabolism in different regions, we shall attain new light that will place this aspect of geographical study in an altogether new and better position. We have recent work by V. B. Appleton suggesting that children of East Chinese stock grow better and also somewhat differently if removed to Hawaii, apparently largely because sanitation is better there and parasitic diseases are less frequent, so the retardations of growth noticed in most of the children observed in East China apparently do not operate in Hawaii. Growth-changes are clearly a most important factor in evolution.

Dr. Hörner's addition to the famous Petermann series will be welcomed both by teachers of geography who want a deeper knowledge of social environments and by explorers who want to realize features that need to be looked for. He looks upon forests as factors of isolation and retardation of evolution on the whole, but is clear that much depends upon the stage of culture attained by people who come into the forest, and also upon the density and climatic conditions of the forest concerned. Anxiety and fear with correspondingly marked development of egocentric interests are very general psychic features; physical ones have often been smallness of stature and deftness of movement; keenness of sense and strength of body often accompany the latter. He enters into all sorts of details of material culture as well as of social organization, and seems to remain reasonably aware of the fact that in human affairs there are exceptions to every generalization.

Dr. Ahrens' book is a short set of notes accompanying a series of maps of each of the continents. His scheme is to give us the types of "landscape" (in

Passarge's sense) in the cold steppes and deserts, the subpolar meadows, the monsoon forests of subtropical regions, the cool pine forests, the tundra-forest, the cool wooded steppe (parkland), the steppe, the intertropical rain-forests, the mixed steppe and gallery forest, the mixed steppe and coastal forest, the regions of hard-leaved trees and the deserts. A map in each case suggests the distribution of the type in the continent concerned, and there are added maps showing distributions and forms of hunting and collecting, of fishing, of cultivation, of plough agriculture prior to European interference, and of stockfarming. The collection is one which will be found very widely useful, and the work is done with judgment even if some of the greater names of student-explorers (like Doughty for example) are not brought in. It would probably be well worth while to translate and publish in England, with some revision, this useful compilation; it does not touch Europe.

If Günther and Hertz deal mainly with European and Hörner and Ahrens mainly with non-European peoples, Pitt-Rivers speaks with deep feeling of the relations between the two, especially in regions where the advent of European culture seems to lead to severe diminution of the numbers of the nature folk. In his view the reproductive function is peculiarly sensitive, and under conditions of culture-revolution the tendency is for fewer children to be born and for the proportion of boys to increase, so that the social normal with an excess of women is overturned and the men may outnumber the women enormously, a state of affairs which is usually a prelude of decay. Of course the author does not apply this idea to populations in pioneer outposts, where the male surplus is quite another matter. Pitt-Rivers' book is one to be read by all who are satisfied about our race superiority and who are apt to think that medical progress is going to open to us intertropical regions far and wide, quite forgetting that medical progress may limit the diseases that meet us in hot climates, but is not likely to alter a constitution that clearly built itself up in the cool temperate zone, and finds its skin relations and general metabolism deeply affected by hot sun and equatorial thunderstorms.

All these problems gain added importance from the fact that men are beginning to visualize the world as an estate to be worked for humanity in general, and are asking how population may be controlled so that all parts of the world may be utilized reasonably and no part may be forced into crises of overpopulation without outlets. These questions were discussed largely from the biological standpoint at the World Population Conference of 1927. The figures of the Italian population year by year from 1872 given by Professor Niceforo tell an eloquent tale of Italy's participation to a considerable extent in the diminution of death-rates with only a comparatively small diminution of birth-rate. He also brings out the increase of wheat and sugar consumption which is such a feature in many lands and cannot but affect the constitutions of many peoples, indeed is said to be doing so rapidly. The geographical point of view was put to the Conference by our President and by Professors J. W. Gregory and P. M. Roxby in various discussions. H. J. F.

THE COMMERCE BETWEEN THE ROMAN EMPIRE AND INDIA. By E. H. WARMINGTON. *Cambridge: University Press* 1928. 8×5 *inches*; x+418 *pages; and a map.* 15*s*

The oriental commerce of the Roman Empire is a subject for which a historian needs to combine a thorough knowledge of the classical sources with a wide range of information in the province of the Indianist or Sinologue. In the present book Mr. Warmington has evinced a scholarship in both these ways adequate, and he has handled his great mass of material with a skill which

should give his book a prominent place in the library of the Roman historian. It should also serve to stress the importance of the subject, still too little appreciated.

The traditional view of the Roman Empire as the whole civilized world of antiquity, as a self-contained unit outside which were none but barbarians, persists even now that history has ceased to mean so exclusively the history of Europe. Such a conception must be greatly modified. Rome participated in a net of commercial intercourse which linked the Mediterranean with Eastern Asia, and the traffic with the East was no mere trickle of merchandise negligible on a broad view of the age, but a trade which assumed vast dimensions and affected essentially the economic being of Rome. It was indeed a traffic in luxuries only, but it was on these luxuries that the wealth of the small Roman upper class was mainly spent. Mr. Warmington agrees with Chwostow in maintaining that "the volume of exports from India during the epoch of the Roman Empire can compare not unfavourably with the conditions of more modern times;" he gives many instances of the "extravagant expenditure" incurred in the purchase of Indian products, reminding us at the same time of the immense fortunes accumulated under the Empire—such as the 400 million sesterces of the imperial freedman Narcissus.

In his review of the Rome–India trade Mr. Warmington deals first with the various trade-routes—those by sea, which developed with the knowledge of the use of the monsoons, and those by land, of which the more northerly served also for the silk-route to China; second, with the particular commodities in which the traffic was carried on; and third, with the question of the adverse balance of trade, and how far this contributed to the decline of the Empire. He inclines to the view that "the drain did perhaps no more than hasten a little a financial collapse which would have come in any case." This part of the book is of great interest, and suggests comparison with Rostovtzev's work on Rome's economic decay. Mr. Warmington gives also a valuable account of the commercial considerations in Roman imperial policy and of the part played by the middlemen in the Indian trade; the Parthians and Axumites cut off Rome from India and China in the same way as the Moslem powers were later to cut off Europe until their position was turned by the voyage of Vasco da Gama.

In matters of detail it may be objected to Mr. Warmington that the gymnosophists were not Buddhists, but Jains of the "sky-clad" sect. As regards the trade mentioned by Strabo as carried on by the Aorsi, it was "received from the Armenians and Medes" and had nothing to do with the Oxus route; the latter, as Tarn and others have shown, cannot have been of any considerable importance in classical times. But these are minor points which do not affect the value of the book as a whole. G. F. H.

IBN FAḌL ALLAH AL-'OMARĪ: MASĀLIK AL ABSĀR. I. L'Afrique, moins l'Égypte. Traduit, etc., par GAUDEFROY-DEMOMBYNES. Bibliothèque des Géographes arabes. Tome II. *Paris: Geuthner* 1927. 10×7 *inches;* lxviii+282 *pages; maps.* 10*s* 6*d*

This volume, though labelled tome II, is the first of the new French translations of standard Arabic geographical texts, which when complete will place the principal sources within reach of European students. It will consequently be examined with interest, as a specimen of what we may expect from the series, as well as for its intrinsic value (enhanced in this case by the fact that only fragments of the Arabic original are generally accessible, though it ranks as the most important of the later descriptive works). The task laid on M. Demombynes has therefore been all the heavier, and it may be said at once that it has been

admirably performed. As in his previous book on Syria, he has prefaced to the main work a full historico-social exposition of the system of government in the region, limited here to North-West Africa. The text takes the African lands one by one: Abyssinia, Western Sudan, Ifriqiya (Tunisia), the Maghrib, and Andalusia (reckoned as a Moorish protectorate), and its survey of political, social, and natural conditions in each is elucidated by detailed notes, collating the results of previous researches and parallel passages from other Arabic sources. The book as a whole thus forms an indispensable work of reference for future students.

Two serious defects will be apparent to every reader. The first concerns the maps, of which there are not nearly enough, while the map of Tunisia contains practically nothing which could not be found in any ordinary atlas. A good map of the Niger territories is especially indispensable, but M. Demombynes contents himself with referring to one contained in an obscure and quite unprocurable colonial publication (at least the reviewer has tried to get a copy, and failed). The second is the poverty of the index, which does not even supply all references to the text, and simply neglects the enormous mass of material in the notes. For many users this is bound to reduce the value of the book very considerably.

In points of detail every reader will doubtless find slips or lacunæ, but the general impression is one of thoroughness and care. The translation, so far as it has been possible to check it, is substantially accurate. Some variations are doubtless due to manuscript readings, and misrenderings are generally trifling. The extreme frontiers of Ifriqiya (p. 99), for example, are not the towns of Tripoli and Dellis, but the boundaries of their districts, which extended, especially in the former case, well beyond the immediate locality of the towns. It is not clear what is M. Demombynes' authority for rendering *hamaj* as "mixed populations"; in all texts known to the reviewer the word is used of tribes living in a degraded and semi-animal condition. The length of the *barīd* on p. 60 should have been defined as either 6 or 12 miles; in al-'Omarī's usage it was probably the former figure. It is difficult to be convinced by M. Demombynes' dismissal of the negro trans-Atlantic expedition (p. 75) as a yarn intended to "astonish the natives" at Cairo, or by his rationalistic explanation of "fish-wool" (p. 126), though both narratives certainly need explaining. And surely the identity of *malukhiya* (p. 103), the familiar Jew's mallow (*Corchorus olitorius*) of Egypt, needs no establishing. But if the other volumes of the collection have no more serious errors to show, they will be welcome indeed. H. A. R. G.

THE VOYAGES AND CRUISES OF COMMODORE WALKER. With introduction and notes by H. S. VAUGHAN. The Seafarers Library. *London: Cassell & Co* 1928. 9×6 *inches;* lii+220 *pages; plates and maps.* 10*s* 6*d*

The author of this book, which was first published in 1760 and reprinted in 1862, is unknown, but Mr. Vaughan inclines to the belief that it was either written, or communicated to the writer himself by Commodore Walker. In any case the author admits that he accompanied Walker on all except one of the cruises that are described, and though he gives no indication of the part he played in the adventures, he writes with a knowledge of the sea and seamanship. Commodore Walker was one of the best type of privateer commanders of the great age of privateering. By profession he was a master in the merchant service who had served in the Dutch navy before he received a letter of marque in 1740 for a voyage to the Carolinas. Thereafter he made a voyage to Russia and, after the declaration of war with France, cruised as a privateer in the Atlantic. The cruises and the fights, of which there were many, are vividly described, and there are

glimpses of life ashore at Lisbon, Madeira, and in the Azores. There were also encounters with Barbary Corsairs and a period during which Walker was a prisoner-of-war in France. Altogether it is an entertaining book, and its value is increased by Mr. Vaughan's long introduction with its history of privateering. The illustrations are reproductions of old paintings of ships and sea fights.

R. N. R. B.

MANY CITIES. By HILAIRE BELLOC. Illustrated by Edmond L. Warre. *London: Constable & Co. Ltd.* 1928 9×6 *inches;* xii+262 *pages.* 21*s*

Mr. Belloc writes lucidly and very sensibly about a number of cities he has visited, some of them familiar to English readers and others known possibly only by name. In the part devoted to Spain Mr. Belloc has caught very deftly something of the immensity of the past and what he calls most happily the grave, profound appeal of that strange country, but he can seldom have done anything better than the description of the shrine at Aachen. Here in half a page we have the very spirit of the place, still marvellously preserved in spite of modern reconstruction, summed up and compellingly expressed. Some of us may not go all the way with him in his enthusiasm for Tournai, but for the rest the impression left on one reader at least is that Mr. Belloc has contrived to say what many travellers have felt but could not express, and if only on this score he has earned our gratitude. The illustrations are delightful. M. L.

FROM THREE YACHTS: a cruiser's outlook. By CONOR OBRIEN. *London: E. Arnold & Co.* 1928. 9×6 *inches;* xii+274 *pages, and portrait.* 10*s* 6*d*

With a long and varied experience of the sea, Mr. OBrien has written a vivid and entertaining book. He believes that cruising should be an easy and luxurious life, and says that most of his sailing has been done in fine weather and in the hope that it would continue fine. That may be true, but this book has some thrilling pages of a battle with a gale in the South Atlantic. Mr. OBrien finds long passages without a break monotonous, and so feels that islands were created to relieve the tedium of long stretches of ocean. He took one or two companions with him on all his cruises, and recommends a taciturn man if one must have a crew. People who ship for such voyages in small boats, like those who plan them, are not, he believes, wholly normal and so are bound to get on each other's nerves. But he contemplates with pleasure a solitary pasage as the most restful and care-free occupation possible. There is plenty of excitement in the book, whether it is gun-running or fishery inspection in the *Kelpie*, cruising or racing in the *Saoirse*, or taking out for delivery at the Falkland Islands the 37-ton *Ilen*. There are glimpses of many ports seen from an unconventional standpoint, and, best of all, there is enthusiasm and humour throughout the book. It is a welcome volume.

R. N. R. B.

THE MONTHLY RECORD

CROP YIELDS IN ENGLAND

Attention may be called to a paper by H. D. Vigor on "Official Crop Estimates in England" appearing in the *Journal of the Royal Statistical Society* (vol 91, pt. 1, 1928). It appears that crop yields of late years have not shown the increases which in certain quarters had for various reasons, including the work of plant breeders in connection with varieties of wheat, been expected, and that as a result the trustworthiness of the estimates has been under suspicion. Mr. Vigor shows that the history of agriculture in England since 1885 does not justify any expectation of increased yields, that there is no evidence that the official estimates fail adequately to recognize all the facts of the case, or that official yields in recent years have been influenced by the system of crop-forecasting. He concludes that in so far as there has been any decline in the average yield of crops in the decade 1915–24 the explanation must be sought in such natural causes as a run of unfavourable years and in the disturbing effects of war-time conditions.

Of more particular geographical interest are references to the works of Hooker and Geddes on the correlation of weather and crops in England and Scotland. These investigations show that all crop yields excepting potatoes show a distinctly greater variability in England than in Scotland, indicating that in the latter country the crops are less affected by variations of weather from the normal. In the discussion of Mr. Vigor's paper Mr. J. M. Caie, of the Scottish Board of Agriculture, suggests in explanation of this anomaly that in the important crop-growing districts of England there is a preponderance of the heavy clay soils which react so adversely to extremes of weather, whereas the glacial drift soils in Eastern and North-Eastern Scotland resist such extremes comparatively well. But it should also be remembered that the variability of rainfall and of seasons from one year to another is rather greater in England than in Scotland; also that in the Continental countries where the variability of rainfall is greater than in England so likewise is the variability (as pointed out in the paper) of crop yields.

Another factor in a complex question which must not be overlooked is the probability (referred to in the paper) that the Scottish farmer, having a generally harder climate to contend with, has been forced to be more progressive in his methods of cultivation than the English.

THE FINNISH–RUSSIAN BOUNDARY NORTH OF 68°

By an agreement concluded in 1920 a strip of territory east of Lake Inara and the Norwegian boundary south of the Varanger fiord was granted by Russia to Finland, whereby the latter obtained access to the Arctic Ocean at Petsamo. At this end the boundary starts from Vaito bay on the Rybachi or Fisher Peninsula and traverses this to the central point of the isthmus connecting it with the mainland, whence it runs in a straight line for 204 kil. to a point a little north of 68°, named Korvatunturi. For the demarcation on the spot a joint commission of three members on each side was appointed, and carried out its labours in the summer of 1921. The methods adopted and the course of the operations have been described by the Finnish members in *Fennia* (the organ of the Finnish Geographical Society) for 1927, no. 13, the account being illustrated by maps. The fact that the country crossed by the boundary had never been surveyed (consisting for the most part of valueless *tundra*); the short period (about eighty days) during which operations could be carried out in any one year; and the absence of all supplies in the country itself, made the undertaking by no means easy. It was decided to fix the two ends of the 204 kil. section as carefully as

possible astronomically, and to lay down the line itself by a determination of azimuth. This might give rise to an error of as much as 100 metres, and it was agreed that if an error greater than this should be proved to have crept in, the line should be re-demarcated on the demand of either side. As traced it was to be marked by the clearing of a line 8 metres broad through the brush and by stone pyramids at intervals of about 10 kil. Triangulation was carried out at points where the direction changes, and a belt 2 kil. wide surveyed topographically throughout. The weather conditions seem to have been anything but pleasant owing to the cold winds and constant rain as well as the plague of flies. When this ceased (in August) it was possible to employ reindeer sledges, but before this all the travel had to be done on foot.

DIVERSION OF THE MOLDAU

The unusual achievement of diverting artificially the course of a great river is described briefly by Dr. B. Brandt in *Petermanns Mitteilungen*, Heft 3–4, 1928. The Moldau at Praha flows in a large meander, the steeper inner side of which gives distinction to the city's site. To improve the docks and the planning of the city, it was decided to divert the Moldau across the meander, thus reducing the river distance between Hetz island and the Holleschowitz docks approximately from 4 to 3 kilometres. By the end of last year the new bed had been cut across the wide flood-plain, and the material from this used to fill up one arm of the Moldau west of the Liebener Werder, and to raise the level of the plain 4 to 5 metres above high water. Some difficulty was then experienced in breaking down the dividing dam and letting the Moldau into its new course. Channels were cut through the dam, and the Moldau itself ultimately completed the destruction.

FORESTRY IN TOGOLAND

The *Empire Forestry Journal*, vol 6, no. 2 (1927), contains a paper by Mr. J. R. P. Gent on "Forestry Conditions in Ho District, Togoland," which though primarily concerned with but a limited area, supplies an object lesson no doubt applicable to other parts of the same zone in West Africa. The Ho district lies to the east of the Volta in the British Mandated Territory south-south-west of the old German station of Misahohe. Its forests are in part Deciduous Rain Forest, in part Savannah Forest; the former having escaped the depredations of man chiefly in uninhabited areas, inaccessible spots, or other specially favoured localities. Elsewhere the natural conditions are so delicately balanced that any unnatural interference with them leads to a transition towards the savannah forest, a type specially adapted to survive the two primary enemies of vegetation—aridity (of soil or air) and fire. The writer is led to the conclusion that in this area the forest once covered much more ground, but has long been deteriorating, not because the natural conditions are unfavourable (the drying harmattan winds being the only adverse factor on this side) but owing to man's action—principally the native custom of shifting cultivation and grass-burning in the dry season. The spread of cacao cultivation also intensifies the attack on the forest, and such perennial crops are held to be generally unsuited to an area exposed as this is to drying winds. It is urged that efforts should at once be made to check further deterioration of the climatic conditions by the creation of forest reserves. This could still be done in the hill ranges to the north, little touched as yet by modern conditions, though in the more southern parts things have already gone too far for anything but local palliatives.

COTTON MANUFACTURING IN THE UNITED STATES

The recent changes in the relative position of cotton manufacturing in New England and in the Southern States is discussed by R. M. Brown in *Economic*

Geography for January 1928. In 1924, for the first time, the active spindles in the south exceeded in number those in New England. The increase in the south was most marked during the period 1890 to 1910. In the earlier year, New England still had 76 per cent. of the spindles for the whole country, but by 1910 the percentage had decreased to 54. During the period 1904–1919, the number of active spindles in N. Carolina had increased 146 per cent., and in Georgia nearly 90 per cent., which may be compared with the greatest increases amongst New England states—Massachusetts 33 per cent., Rhode Island under 25 per cent. There is also a great difference in activity in the two regions: during 1925 the percentage of spindles idle in Massachusetts was 16; in North Carolina it was 1·2. This rapid rise of the manufacturing industry in the south is sometimes attributed to the proximity of the cotton fields, but Mr. Brown shows how slight an effect this exerts. The southern manufacturers now have to go beyond their own boundaries for the raw cotton, and to compete with New England on practically equal terms. For example, in 1924, South Carolina's production of cotton was only 80 per cent. of that consumed in her mills. Texas and the south-west are coming to stand to the Carolinas in the relation in which the latter once stood to New England. It has also been stated that the southern industrial development is due to better facilities for power, but again it is shown that north and south enjoy practically equal opportunities in this respect. A powerful factor is the legislation imposing a 48-hour week in New England, whereby the number of working hours per spindle is much less in the north than in the south. North Carolina in 1923 obtained 3460 working hours per spindle, as against Massachusett's 1341 hours, a difference, it is true, not entirely accounted for by this legislation. Wages also enter into the consideration: Connecticut pays frame spinners, for example, over twice as much as Alabama. Changes in fashion and depression of the markets have also hit the northern states harder, since they manufacture finer types of goods. It is anticipated, however, that conditions in the south, as the result of labour organization, etc., will soon approximate to those in New England.

THE RAILWAYS OF BRAZIL

A concise summary of the present position of railway development in Brazil, with notes on the past history of the subject, is given by F. Orteis in the May 1928 number of *Le Vie d'Italia e dell' America Latina*. Considering the vast size of the country, the total mileage of all the Brazilian railways is of course exceedingly meagre, amounting at the end of 1924 to only 30,628 kil., distributed among fifty-eight separate companies. Only four of these have a system exceeding 2000 kil., the Leopoldina Railway, which operates in the area north and north-east from Rio, standing at the head with nearly 3000. Apportioned by states, the railways of Minas Geraes stand first with over 7600 kil., São Paulo coming next with about 6800. The whole vast state of Amazonas boasts of only 5 kil., representing the Madeira–Mamore line (probably the most isolated in the world), while the Acre Territory has yet none at all. If we divide the whole country into zones—north, central, and south—we find that the first, with nearly half the whole area and 43 per cent. of the total population, has only a fifth of the mileage; the central group is in a better position, area, population, and mileage being each about a quarter; while the southern is decidedly the best off, with a tenth of the area, a third of the population, and about half the whole railway mileage. Various causes account for the slow development of the Brazilian railways taken as a whole. They were originally evolved as independent systems to supply communication between the various interior districts and the nearest port, so that not only is there no unity of control, but there is great diversity of gauge. The formidable barrier of the Serra do Mar, running

parallel to the coast for 1600 kil. with an altitude of some 1000 metres, has been a serious physical obstacle, as is well brought out by some of the photographs showing the engineering feats by which it has been surmounted at seven different points. Again, while in settled districts like the coffee area of São Paulo the railways can pay their way, government subsidies have been needed for lines across the wide sparsely-populated tracts of the interior, where railway construction has been largely suggested by political and military considerations. Besides the photographic illustrations the article is illustrated by maps of the more important systems.

THE PRESIDENT'S ADDRESS

Two slight errors occur in the President's Anniversary Address, printed in the August *Journal*. The sentence beginning in line 26, page 113, should read "the International Conference on the Map of the World had met in London in November 1909 (*not* 1913); and Peary had reached the Pole on April 6 (*not* 7) of the same year." On page 115, line 8, the sentence should read "The situation is still not perfectly clear, though the International Research Council, in June 1926 (*not* July 1925) rescinded its regulation against the admission of the 'Central Powers.'"

THE SALTS IN THE JORDAN BASIN

The June 1923 and December 1925 numbers of the *Geographical Journal* contain Reports of investigations into the origin of the salts in the Dead Sea contributed by Mr. Wilfred Irwin, of Cockermouth. It is with great regret that we record his death, which took place in the Government Hospital at Jerusalem on April 11 last. Mr. Irwin visited Palestine in March to carry out further investigations into the origin of the salts in the Dead Sea, and his brother has sent us the following brief note upon their results. He paid special attention to the Lake of Galilee, sampling and testing the water at a large number of points. The outfall of the lake into the Jordan proved to be heavily charged with salt, whereas the river at its entry into the lake was quite pure. None of the streams flowing into the lake showed the presence of chlorine, so that the only alternative seemed to be the possibility of submerged brine springs. He therefore cruised over the lake in a boat manned by Arabs, taking samples at various points both on the surface and from the floor of the lake. Local residents had stated that there was a particular tract where the water was warm and that this tract was haunted by catfish. The shoal of catfish was found, but the thermometer did not reveal any increase in temperature above the normal of the lake. At this point the depth was 50 feet, and samples drawn from the floor showed 3060 parts per million of chlorine. It is therefore possible that there was in the immediate neighbourhood a submerged spring of great volume and salinity. Mr. Irwin unfortunately was compelled to suspend his investigations in order to return to Jerusalem for business appointments, and while there illness came on which proved fatal. Some future investigator may be able to make a detailed survey of the lake and complete Mr. Irwin's work.

PROF. BENEDETTO'S EDITION OF MARCO POLO

On the publication of Cav. de Filippi's review of Prof. L. F. Benedetto's recent edition of Marco Polo in the March *Journal*, Mr. N. M. Penzer wrote questioning three statements in it. The following paragraphs are condensed, with some explanatory notes, from the correspondence which ensued.

The first statement challenged by Mr. Penzer was: "It is from the 'geographical text' that H. Murray's translation was made (1844)" (*G.J.* 71, 278). In reply to Mr. Penzer, Cav. de Filippi wrote that he had not been able to consult a

copy of Murray's edition, but that he had no doubt that "its originality in respect to earlier English versions has derived precisely from having had at least one of its sources in the 'geographical text.' " Mr. Penzer answered that the whole point of Murray's translation is that he used the Latin in preference to the French (or geographical) text as his basis. He quotes statements from Murray's preface in support: "We have taken it (*i.e.* the Latin MS.) as the basis of our text, carefully incorporating, however, all the additional information contained in the French version; and where a difference exists, usually preferring its authority" (Murray, pp. 30–31).

The second statement Mr. Penzer questioned was that "Prof. Benedetto has traced all the sources of this Italian version" (p. 279). [The version referred to is that of Ramusio.] Developing this statement, Cav. de Filippi writes that the assertion that Benedetto, by the discovery of Z (*i.e.* a copy of the Latin text of "marvellous antiquity" mentioned by Ramusio), has traced all Ramusio's sources is to be taken in connection with the whole treatment of Ramusio's text by Benedetto. He has analysed it exhaustively and shown the various sources upon which Ramusio drew. Separating out everything in Ramusio that can be attributed to other texts, he obtained a residue of passages, some of which have their counterpart in Z, others being referable to Z′, a codex now lost, but the existence of which Benedetto has proved beyond doubt, and which may, with the help of Z, be conjecturally reconstructed. Until a more complete text is found to substantiate this, Ramusio remains the sole authority for it, and Benedetto has demonstrated that Ramusio is trustworthy so far as he can be checked at present. He has shown that the remainder must be derived from the long-lost Ghisi codex. To this Mr. Penzer replies that Z adds very little to the first half of Polo's text, a fact largely responsible for Benedetto creating Z′. He believes himself in the existence of a Z′ text, but until it has actually been found and compared with Ramusio's, it cannot be said that Benedetto has traced all the latter's sources. He has *indicated* them. Mr. Penzer realizes the magnitude of Prof. Benedetto's work; his point is simply that Cav. de Filippi somewhat misrepresented his actual achievement.

The third point at issue is of importance in historical geography. The original passage in De Filippi's review criticized by Mr. Penzer ran, "There is a new chapter on Russia, and one on Khara-Khoto, the buried city of Central Asia which was explored by Col. Kozloff in 1908–09 and by Sir Aurel Stein in 1913–16. Sir Aurel believed that the site corresponded with Polo's 'City of Etzina' (cf. *G.J.* 48, 197), but here is the place with its name 'Charachoto' (though misspelt 'Charachoco' by the copyist)." Mr. Penzer questioned two points in this statement: (1) that the new "Charachoco" is to be identified with Khara-Khoto, (2) that Sir Aurel Stein was mistaken in identifying Khara-Khoto with the "City of Etzina." He suggested that Cav. de Filippi had confused Khara-Khoto with Khara-Khoja (which he himself believed to be "Charachoco") and that the new passage, therefore, did not shake Stein's identification of Etzina. Cav. de Filippi replied that he had never mentioned Khara-Khoja. In agreement with Benedetto, he considered the identification of Khara-Khoto with the "City of Etzina" was doubtful, because Polo describes the latter city as a pastoral and agricultural community, explicitly excluding higher economic activity. In the Khara-Khoto ruins, on the other hand, Kozloff and Stein found important monuments and artistic remains as befitted the site of the important cultural centre described in the new version under the name of "Charachoco."

In contesting this conclusion Mr. Penzer draws attention to the evidence of Polo's itinerary. On reaching Sachiu (the modern Tun-huang), Polo halts to describe the country to the north-west, not visited by him, but apparently by

his father and uncle in their first journey. Polo then continues his journey from Sachiu eastwards. This digression deals with the province of Camul (Hami) and "Ghinghintalas," that is, the area stretching from Turfan to Hami. [Yule, in treating of this passage, actually refers it to the area round Khara-Khoja, 1, 216.] Now the new passage in the Z text discovered by Benedetto, describing "Charachoco," comes right in the middle of this digression, immediately suggesting Khara-Khoja, 21 miles E.S.E. of Turfan. The context which describes "Charachoco" as "principalior civitas" of "Icoguristam quedam provincia magna," strongly supports this conclusion: for "Charachoco," the capital of Uighuristan, must be identical with Khara-Khoja "the Turfan capital of Uigur times" (Stein, 'Desert Cathay,' ii, 359). If it is identical with Khara-Khoto, the position in the text implies that Polo jumps 600 miles to the east of Sachiu, describes Khara-Khoto under the name of Charachoco, returns to Sachiu, and continues to describe a route which carries him eastwards nearer and nearer to Khara-Khoto. After passing Campichu he describes "Etzina," twelve days' ride to the north, on the verge of the desert, corresponding with the position of Khara-Khoto. De Filippi's objection to the site of Khara-Khoto for Etzina because the latter is described by Polo as a pastoral and agricultural community, while Khara-Khoto is rich in cultural relics, loses its force when it is remembered how Khara-Khoto suffered under Chingiz Khan in 1226. Polo knew of it, quite correctly, only as an agricultural community. Polo's itinerary and the reference to "Icoguristam" make it practically certain that "Charachoco" is Khara-Khoja, and not Khara-Khoto. There is therefore nothing in the new passage to discredit Stein's identification of Khara-Khoto with the "City of Etzina."

While this correspondence was in progress, Cav. de Filippi sent a transcript of this new passage to Sir Aurel Stein, who had not then seen Prof. Benedetto's work, for his opinion. Sir Aurel replied that he believes "Charachoco" has nothing to do with Khara-Khoto, but is "the well-known Khara-Khoja, the old capital of Turfan, the ruins of which, dating down to Uigur times, have yielded such abundant archæological spoil. 'Icoguristam,' of which 'Charachoco' is described as the capital, is clearly a mis-read Uighuristan, the name by which the Turfan territory, the chief seat of Uigur domination in medieval times, was generally known at Marco's date. . . . Everything in the description of Charachoco fits Khara-Khoja and Turfan most accurately." The letter concludes with an interesting comment which confirms Mr. Penzer's argument. Unaware in what place the new passage occurs, Sir Aurel suggests that it might be "somewhere near Yule's chapters XLI and XLII, which deal with territories to the north-west of Sachiu"—which is precisely where it is interpolated. The correspondence has therefore established the identification of Charachoco with Khara-Khoja.

MR. RICKMERS' PAMIR EXPEDITION

Mr. W. R. Rickmers, whose previous researches in the mountain ranges of Central Asia are well known, is at present leading a new expedition to the Pamir region, the personnel being partly Russian partly German. We are informed that the party reached the Great Karakul lake, by well-known routes, on July 2. Bases for meteorological, wireless, and other observations were to be established at Osh, Saritash, and the Great Karakul, after which the leader, with a small party of scientific men and mountaineers, would proceed to the special field of mountain exploration at the head of the Bartang river. The expedition is organized on a large scale, the whole being composed of 60 men, 180 pack-horses, and 70 camels.

OBITUARY

OTTO NORDENSKJÖLD

THE death of Professor Otto Nordenskjöld at the beginning of June has deprived the Society of one of its most distinguished Corresponding Members and the world of polar travellers of an explorer who had established a lasting reputation both in Antarctica and in Greenland. Otto Nordenskjöld, though spelling his name differently, was a nephew of Baron A. E. Nordenskiöld of the *Vega*, being a boy of ten at the time of the voyage through the North-East Passage: his work proved him no unworthy successor to his uncle, and the lustre of a great name suffered no diminution in the nephew's hands.

Trained as a geologist, Nordenskjöld soon obtained a lecturing post at Upsala (1894); and he was ultimately installed (1905) in the chair of Geography at Göteborg University. Few University professors of his subject have been so widely travelled. Before reaching the age of thirty he had already made expeditions both to Tierra del Fuego (1895–7) and to the Yukon (1898). It was by his own individual efforts that he persuaded Sweden to join in the international Antarctic campaign at the end of the nineteenth century; but it was not an easy matter to overcome financial difficulties, and his expedition ship, the *Antarctic*, did not finally sail for the South till the autumn of 1901. During the preparations, however, he had found time to spend the summer of 1900 with the Amdrup-Hartz Expedition in East Greenland. Nathorst the year previous had shown the geological possibilities of Franz Josef Fjord: to Nordenskjöld fell the agreeable task of continuing the exploratory survey in Davy Sound and on Jameson Land. The resulting memoir could not be published till 1907, but it at once became, and remains, the standard work on the geology of East Greenland.

In the *Antarctic* Nordenskjöld had a ship which had already faced the ice of the Greenland Sea and of the Antarctic itself. He was no less fortunate in his captain, C. A. Larsen; Larsen himself had discovered Foynland in 1893, and he was therefore already familiar with the proposed field of exploration on the north-western side of the Weddell Sea. In January 1902 a shore party of six was landed at Snowhill Island, and according to plan the *Antarctic* returned northwards to carry on survey and exploration in South Georgia. That episode is a notable one, for as a result of what he saw Captain Larsen later (1904) formed the first of the South Georgia whaling companies—not the only instance of economic advantages accruing from polar exploration.

In October 1902 Nordenskjöld made a notable sledge journey south-westwards from Snowhill across a low barrier towards Foynland. The distance travelled appears small in comparison with Scott's and Shackleton's achievements: it was not however an effort to create a record of "farthest south." Nordenskjöld and his companion accomplished what they set out to do—a careful survey, geographical and geological, of the east coast of Graham Land. Prominent among the results of the expedition was the finding not only of fossiliferous Mesozoic beds but also of igneous rocks affording evidence for the view that the mountains of Graham Land are in reality a continuation southwards of the volcanic range of the Andes.

When the *Antarctic* turned once more to the south to relieve the Snowhill party in December 1902, it was to find the Weddell Sea more than usually ice-filled. Snowhill was unattainable. A party of three under Gunnar Andersson were landed on 29 December 1902 at Hope Bay to carry word through on foot to Nordenskjöld, while Larsen made a second effort with the ship. Both these attempts failed: the *Antarctic* was crushed in the ice pack, and the crew with

difficulty escaped over the ice to Paulet Island. Meantime Gunnar Andersson's party had failed to get south and had to retreat northwards and set up improvised winter quarters at Hope Bay, and it was not till October 1903 that they were able to get through to Snowhill. November 8 was a notable day: in the morning the Argentine relief ship *Uruguay* reached Snowhill; and the same afternoon Larsen arrived by whale boat from Paulet Island to report the loss of the *Antarctic*. A few days later all were reunited and the expedition returned in triumph to Buenos Aires.

It is not too much to say that Nordenskjöld's Antarctic work was probably the most useful in the realm of pure science of all that was accomplished by the many expeditions during the international years, 1900–1904. Like all his rivals he had hopes of returning to the promising field which he had found; he had indeed received promise of British co-operation for renewed work in 1914, promised help of which we may well be proud, but the war interfered. Later (1920–21) his early attraction to South America once more reasserted itself; and he had but just returned from a further two years' expedition at the time of his death.

Nordenskjöld never sought the notoriety and popular acclaim which fall to most polar travellers. Like W. S. Bruce he was content to make the acquirement of scientific knowledge the one aim of his expeditions: like Bruce he was also to experience popular indifference and the consequent difficulties of paying off the debts of a too costly expedition. The comparison need not stop there; not only was there the same absence of all self-seeking, but these two men can also be linked as the first fully trained geographers to take part in the exploration and opening up of Antarctica.

J. M. W.

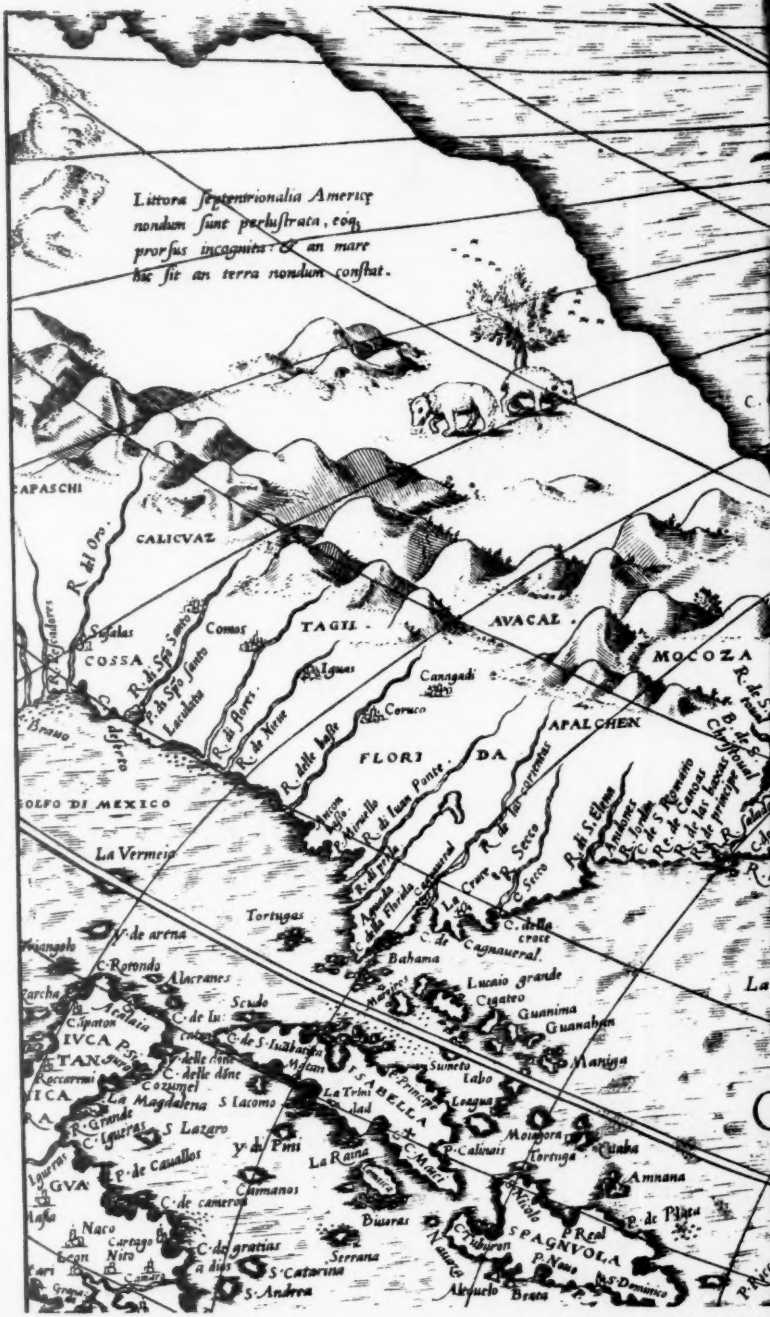
CORRESPONDENCE

'INTERMEDIATE COMMERCIAL GEOGRAPHY'

In his generous notice of Part I of my 'Intermediate Commercial Geography' (*G.J.*, July 1928) your reviewer is wrongly informed in making two of his minor criticisms. Egyptian railways are now standard gauge and hence are correctly shown on Fig. 193, although those in the Sudan should have been indicated as 3 feet 6 inches. Concerning Fig. 11 it would, of course, be foolish to use Mercator's projection where comparisons of area are involved, but since the contrast there is merely between the northern and southern hemispheres, I felt justified in stressing my point by using Gall's projection, which is employed for the majority of world maps throughout the volume.

L. Dudley Stamp.

London School of Economics.



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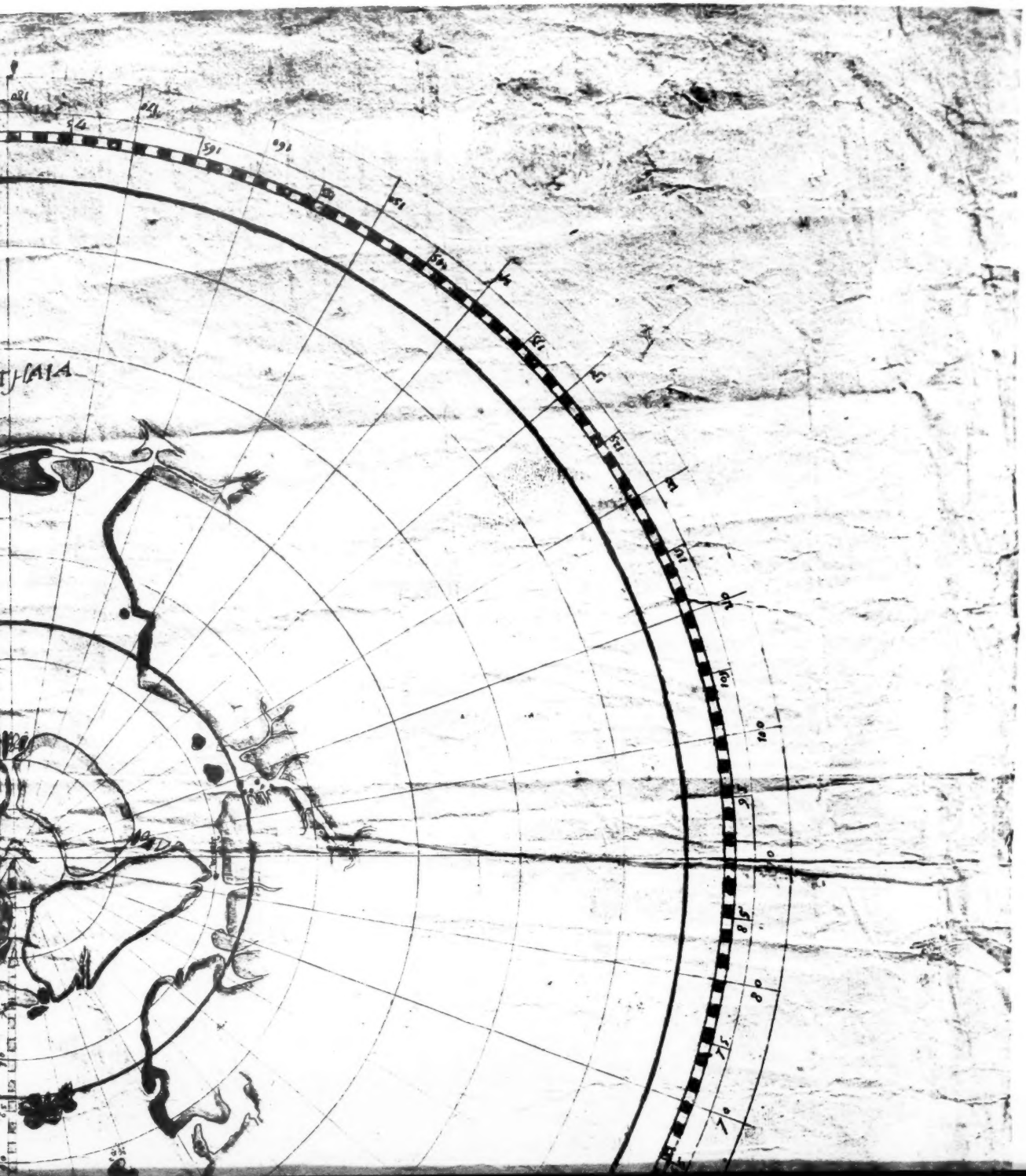
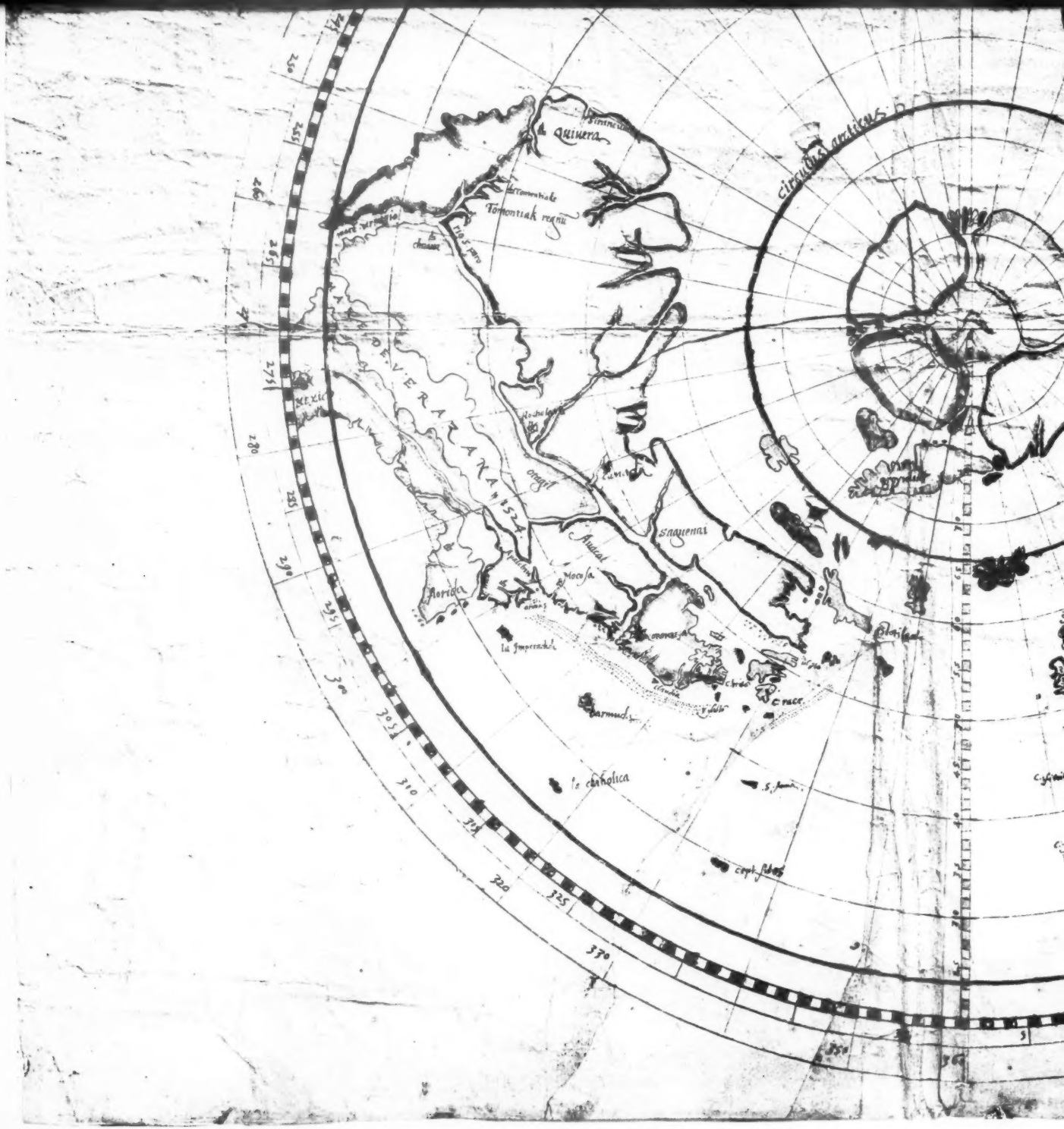
SECTION OF ORTELIUS MAP, 1564

IAPAN
CATHAIA
Tomontiak regni
Circulus antarcticus
Aoriaca
Moesa





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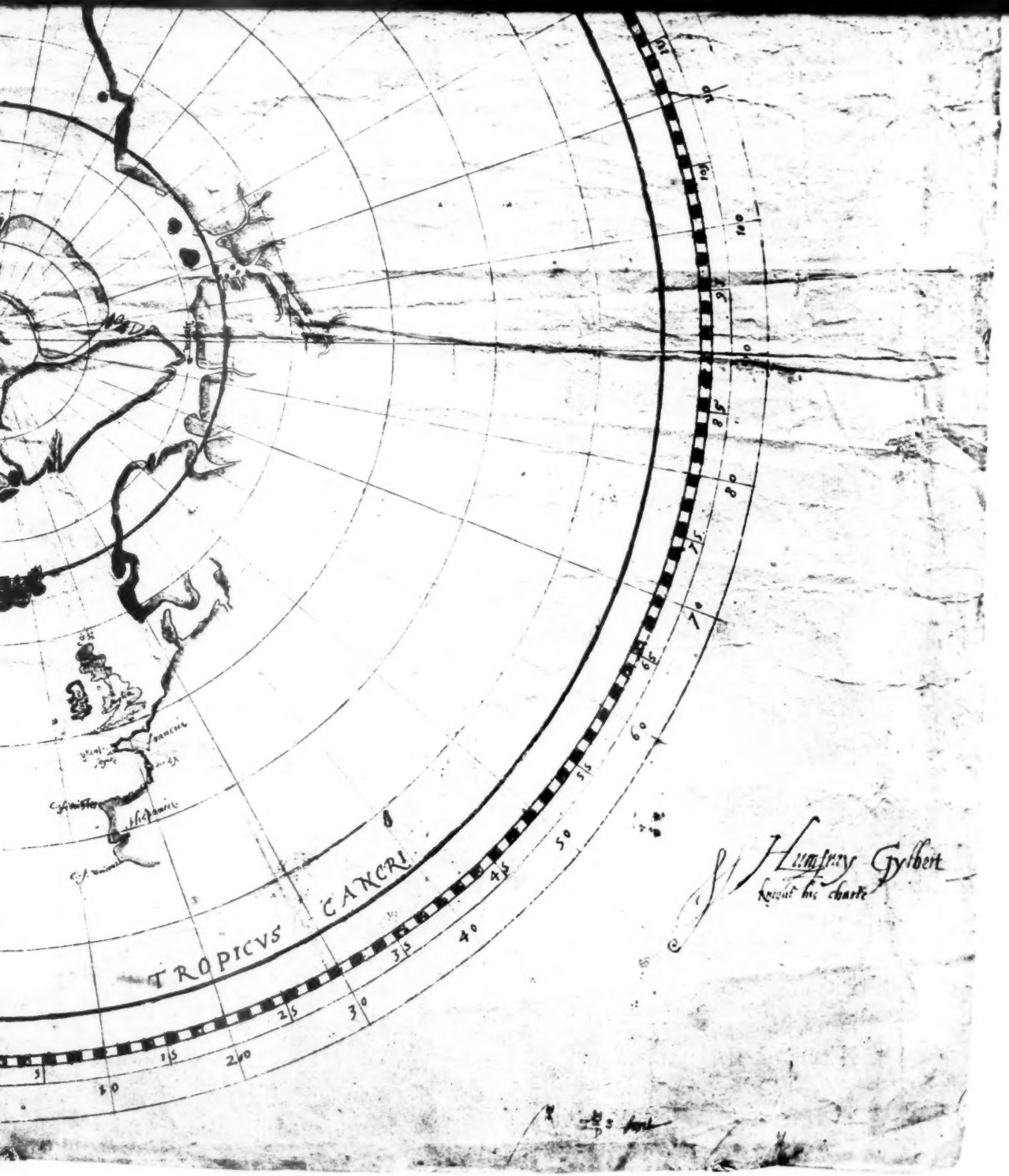

THE GILBERT MAP c.1583